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Surgery, Gynecology and Obstetrics

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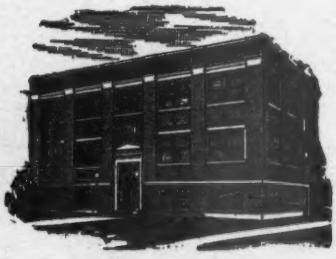

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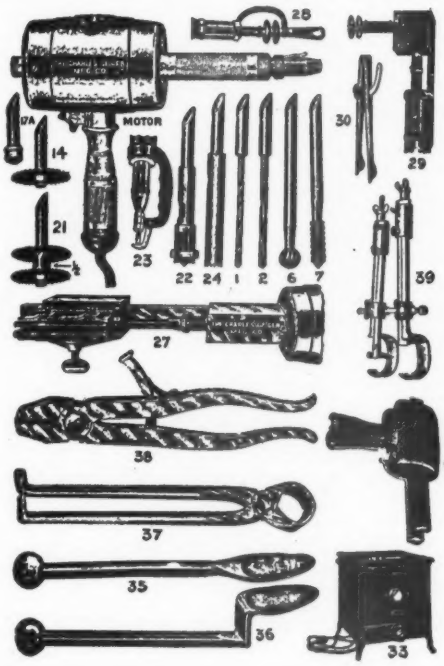

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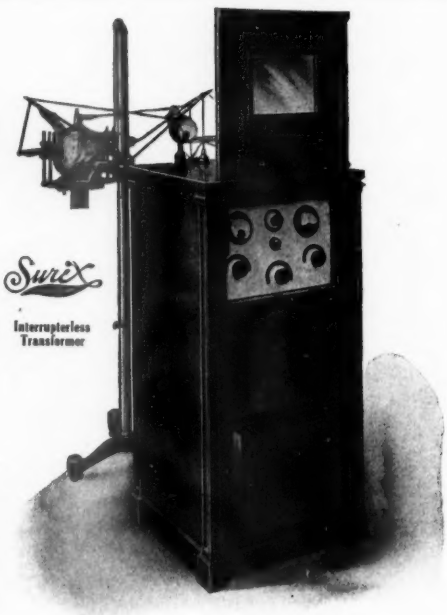

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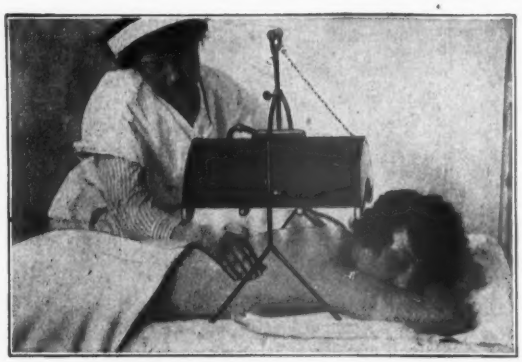

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ANKYLOSIS OF THE JAW[1]

BY M. S. HENDERSON, M.D., AND G. B. NEW, M.D., ROCHESTER, MINNESOTA
From the Mayo Clinic

THE different methods employed in the treatment of ankylosis of the jaw and the length of time elapsing before patients apply for treatment after almost a complete fixation would seem to indicate that the good results obtained by arthroplasty of the temperomaxillary joint are not generally known.

During the last eight years at the Mayo Clinic 23 cases of ankylosis of the lower jaw have been treated; 14 within the last three years. Depending on the location of the fixation, such cases divide themselves into three groups: (1) the articular type in which the joint alone is involved; (2) the extra-articular type in which the fixation is extra-articular, such as scarring in the muscles of the cheek or temporal region; and (3) the articular-extra-articular type in which the cause of the ankylosis is both within and without the joint. Of the 23 cases 15 were articular, 5 extra-articular, and 3 articular-extra-articular. Twenty-two resections of the condyle were done, 19 in the articular cases, and 3 in the articular-extra-articular cases.

ETIOLOGY

The etiology of the articular cases of ankylosis is either traumatism or infection extending into the joint by direct extension or by the blood stream. Blair, in reviewing the literature of the articular variety of ankylosis, states that 50 per cent of the cases are due to trauma on the chin. In our group of cases only 3 (20 per cent) were due to this cause. Murphy states that most cases of ankylosis of the jaw are due to extension from middle-ear infection directly into the glenoid cavity or over the base of the zygoma into the joint. In one only of our cases was an ear infection the probable cause of the ankylosis. A child developed a running ear after scarlet fever, and this was followed by ankylosis of the jaw on the same side. Table 1 shows the various causes to which the condition is attributable in our group of cases:

TABLE 1

TWENTY-THREE CASES

Articular	15
Trauma of the chin	3
Recurring dislocation of jaw	1
Osteomyelitis of jaw	1
Scarlet fever	1
Measles	1
Abscess of cheek over articulation	1
Arthritis	1
Not stated	1
Fever	1
Typhoid	2
Tonsillitis	1
Diphtheria	1
Extra-articular	5
Infection of cheek from teeth	1
Slough of cheek from "salivation"	1
Abscess of temporal, region cause unknown	2
Temporal abscess from wisdom tooth	1
Articular-extra-articular	3
Three unsuccessful tonsillectomies and quinsy	1
Abscess outside of ramus from teeth	1
Base-ball injury over joint and secondary abscesses	1

[1] Presented for publication February 1, 1918.

It should be remembered that on account of the early age at which this condition often occurs, it is sometimes difficult to secure a clear history of the cause of the trouble. In the extra-articular cases some fixation in the muscles or structures about the joint such as scarring of the muscles of the neck or temporal region secondary to abscessed teeth, tonsils, etc., caused the ankylosis. In one case the fixation was inside the lower jaw owing to the scarring following quinsy and attempted tonsillectomy.

In most cases, the age of the patients at the time of the occurrence of the articular type of ankylosis of the jaw was under 10 years.

TABLE 2

Age	Cases
1–10 years	9
11–20 years	3
21–30 years	2
53 years	1

The ages of the patients at the time of the occurrence of the extra-articular and articular-extra-articular types are shown in Table 3.

TABLE 3

Age	Cases
1–10 years	2
11–20 years	2
21–30 years	2
31–40 years	1
41–50 years	1

In the latter group the condition seemed to be about equally divided over the first five decades. In the articular group 9 of the 15 cases occurred in patients under 10 years of age. Taking these two groups as a basis, it is seen that nearly 50 per cent of all cases of ankylosis of the lower jaw occurs in the first decade. As may be noted in Table 4, most of the patients do not come for operation until they are between 21 and 30 years of age.

TABLE 4

Age	Cases
1–10 years	4
11–20 years	6
21–30 years	10
31–40 years	1
41–50 years	1
51–60 years	1

PATHOLOGY

The growth of the ramus of the jaw is largely dependent on the epiphysis of the condyle and any fixation of this with consequent loss of function interferes with the development of the jaw on the side affected. The underdevelopment and shortening of the affected side causes the typical deformity seen in such cases. The center of ossification of the condyle does not unite with the ramus until the fifteenth year. Injury to or fixation of the condyle before the jaw is fully formed would cause the lack of development of that side. In the fibrous type of ankylosis fibrous adhesions occur in the joint, while in the bony type the entire joint is sometimes obliterated and the condyle and zygoma form one mass of bone with no definite landmarks. In the extra-articular group the scarring prevents the normal elasticity of the muscles, usually the temporal, masseter, or pterygoids and thus limits the movements of the jaw.

PHYSICAL FINDINGS AND DIAGNOSIS

The case of unilateral ankylosis of the lower jaw, if the condition has occurred before the jaws are fully formed, presents a typical picture (Figs. 1 and 2). The chin is markedly retracted and is displaced toward the affected side, which appears full and rounded while the normal side is flattened. The midline of the lower jaw is displaced to the affected side and when the patient separates the teeth, if there is any movement of the jaw, the midline moves to this side. Roentgenograms of the ascending rami show a shortening of the ramus of the affected side (Fig. 3). If the ankylosis is bilateral or has occurred after the complete development of the jaws, then the findings are altered. In the latter group of cases it is sometimes impossible to differentiate the side involved from the physical findings alone. A differentiation between a bony and fibrous ankylosis is usually readily made as the bony type allows of practically no movement of the jaw. The amount of movement that can be obtained in unilateral bony ankylosis at times is surprising. In bony ankylosis a definite diagnosis of the side affected can only be made if the condition has occurred early in life, when there is typical deformity, or when the patient's history shows definitely the side affected if there is no deformity.

Fig. 1 (at left). Bony ankylosis of right lower jaw. Note retrusion and displacement of the chin to the right and the flattening of the left side of the face.
Fig. 2. Same as Figure 1 after arthroplasty.

In older patients with fibrous ankylosis, a very slight movement of the jaw will sometimes serve to establish the affected side. Roentgenograms of the joint itself are usually of little value, as the physical findings are sufficient to determine whether the ankylosis is fibrous or bony, although occasionally a roentgenogram is obtained from which a diagnosis of bony ankylosis could be made from the plate alone. Nine of the 15 cases of articular ankylosis in our group were bony, and 6 fibrous.

Little was noted in the literature of the clinical differentiation between the articular and extra-articular types of ankylosis, though usually such differentiation is not difficult. Two of our patients (adult men), in whom there was no deformity, serve to illustrate this point. The side affected was easily determined by the divergence of the jaw to the side affected when the teeth were separated, the condyle on that side having very little movement while the opposite side moved quite readily. In one of the patients, the ankylosis came on after attempted tonsillectomy and recurring quinsy, and in the other following a recurring abscess of the cheek outside the ascending ramus. In both instances it was impossible, until the joint was explored and resected, to determine that the ankylosis was the result of two factors, namely, the articular and the extra-articular. The question of the coronoid process being the cause of any fixation was readily ruled out in these two cases. There was sufficient scarring in one case inside the ramus, and in the other outside the ramus, to prevent the teeth separating more than 1 inch.

TREATMENT

For many years excision has been the surgical procedure for ankylosis of the temporomaxillary joint. In the main, the results have been satisfactory, but the occasional failure has spurred surgeons to modify the technique. The impetus given by the late J. B. Murphy to the use of a flap of autogenous fat, or fascia in arthroplasties has led the majority of writers to recommend the placing of such tissue between the denuded bone ends when operating on the jaw for ankylosis. Baer has advised the use of chromacized pig's bladder and reports good results.

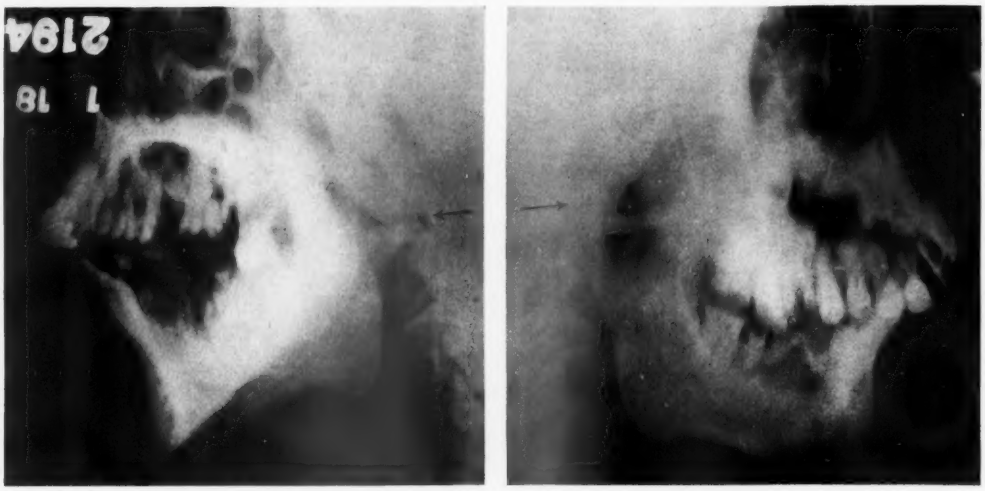

Fig. 3. Patient 25 years of age. Comparative shortening of right ascending ramus. Ankylosis of the right lower jaw which came on following typhoid fever when patient was 11 years of age.

Excision of the joint is, however, the basic principle of each method advised. Any operation which is designed to give motion to a previously ankylosed joint or one in which the motion is sufficiently restricted to prevent the function of the joint, should be called an arthroplasty whether the technique of such operation demands merely the removal of enough bone to allow motion, or, whether it includes as a step, the interposition of fat, fascia, or some foreign substance between the bony surfaces to prevent a subsequent ankylosis.

The operation herein described is an arthroplasty, because it has as its object the establishment of sufficient motion to permit function of the part affected. The facial nerve and the internal maxillary and superficial temporal arteries are the structures the surgeon must bear in mind and familiarize himself with before undertaking the operation. The facial nerve, after it leaves the stylomastoid foramen, passes downward, outward and forward through the parotid gland and divides just posterior to the ramus of the mandible into the terminal branches; the temporofacial and the cervicofacial. It is to the former branches that damage is most likely to be done during the operation under discussion. These branches run upward and forward from just below and in front of the external auditory meatus as they arise in the parotid gland from the main nerve. The external carotid artery branches into the superficial temporal artery and is continued on as the internal maxillary. The superficial temporal branch runs straight up to the temporal region, being superficially placed close to, and in front of, the external auditory meatus. The internal maxillary artery is deeply situated and on its way to the pterygoid fossa of the sphenoid bone courses close to the inner side of the neck of the ramus of the mandible (Fig. 4). It is not especially liable to injury and is well out of the way if, during the operation, all work is kept close to the bone. Some little bleeding may occur from the articular branches which are given off, but packing with a hot salt sponge for a minute or two controls this if it proves to be annoying. If the bleeding is persistent, and considerable in amount, it means that damage has been done either to the superficial temporal artery, which lies behind, or to the internal maxillary itself.

Taking these anatomic structures into consideration it will be seen that there is a

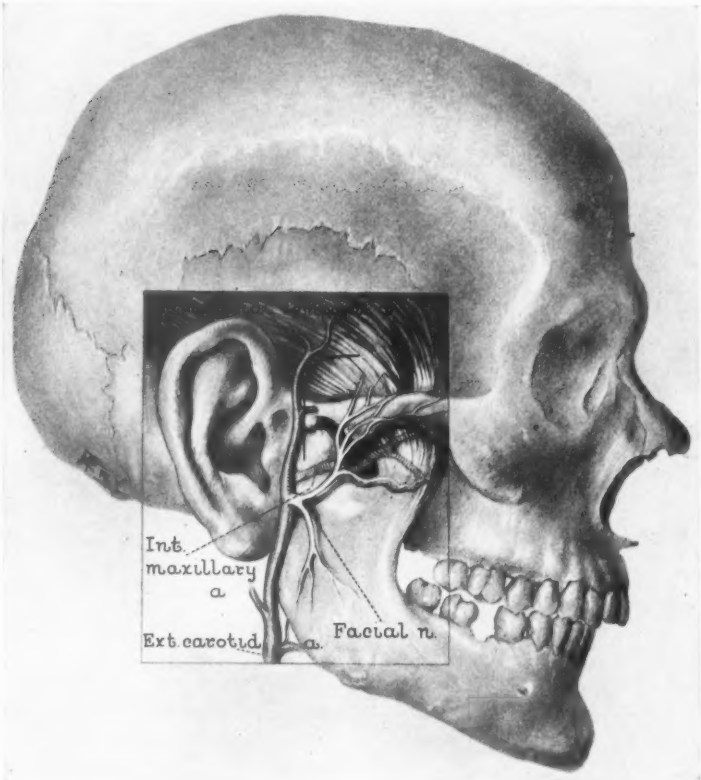

Fig. 4. Note the superficial temporal artery, internal maxillary artery, facial nerve and the location of the incision.

triangular area with the base upward lying over the temporomaxillary joint which is practically devoid of important anatomic structures, and permits a ready and safe approach to the joint. To carry out the "safety first" idea to its completion, as regards the facial nerve, the approach should be consistently made from above, and in order to do this the lower portion of the zygoma over the joint must be sacrificed, but a bridge is left so that no deformity will result. This approach is particularly of value in a case with marked deformity in which the joint is very low, and in order to expose it directly it would be necessary to injure the facial nerve. Hartley has described an operation very similar to that used by us except that he begins the incision behind, and turns the ear down, thus necessarily dividing the superficial temporal artery, a matter of very little consequence, however.

The incision used by us is curved and about 2 inches long. Its anterior and upper portion runs one-half inch above and parallel to the zygoma. The posterior arm extends downward just in front of the ear to about the level of the floor of the external auditory canal. This skin flap is partially dissected free in order to expose the zygoma. If necessary, the superficial temporal artery may be divided. An incision parallel to the zygoma and directly over it is made and the temporal fascia is retracted downward, exposing the zygoma and the joint region. The

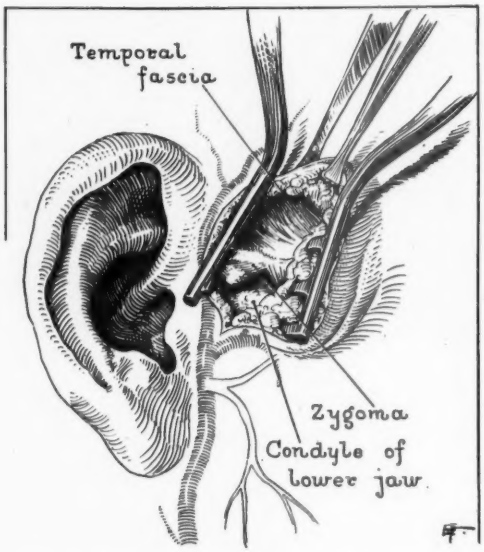

Fig. 5. Exposure of the zygoma and condyle. The retractor holds the soft tissues and facial nerve downward and forward in the flap.

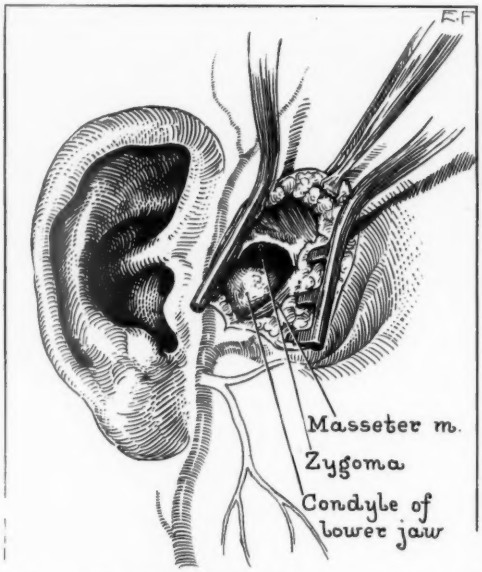

Fig. 6. The zygoma over the joint is removed, giving a better exposure for the removal of the condyle. Note small bridge of zygoma remaining.

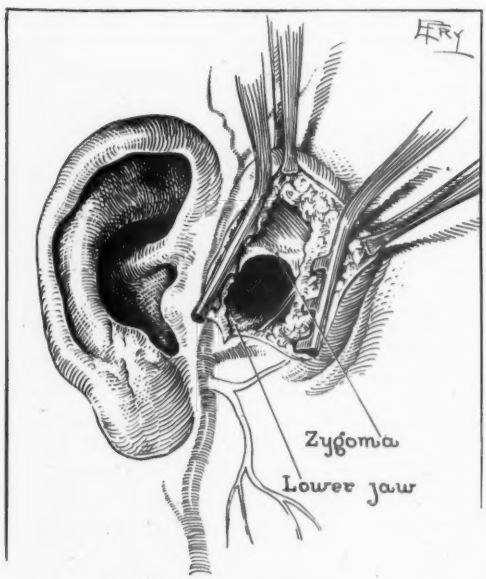

Fig. 7. The condyle removed, exposing the space between the upper end of the ascending ramus and skull.

entire flap is then turned downward and forward, carrying with it and holding out of the way of injury, the temporofacial branch of the facial nerve. The safest form of retraction is by the use of a self-retaining mastoid retractor placed obliquely in the wound (Fig. 5). If the retraction is left to an unskilled assistant, he may, in his zeal for exposure, use too much force and a temporary facial paralysis will occur, the result of stretching. The next step consists in the removal of the part of the zygoma directly over the joint area, care being taken not to injure the external auditory canal, and to leave a small bridge of the zygoma to maintain facial contour. This exposes the condyle and it can be removed with a chisel gouge (Fig. 6). The bone to be taken out should be carefully removed by chiseling off small pieces. If rongeur forceps are used and big bits taken, and the bone is twisted out, the internal maxillary artery may be injured. It not infrequently happens that when there is a bony ankylosis the ramus and even the coronoid process is involved in the mass.

Fig. 8

Fig. 9

Fig. 10

Fig. 8. Fibrous ankylosis of the right lower jaw. Note displacement of the midline of the lower jaw to the right.
Fig. 9. Note typical retrusion of the chin. Same case as Figure 8. Also note scar from operation of arthroplasty.
Fig. 10. Same as Figure 8 after operation.

A large quantity of bone must then be removed and a space at least one-half inch in width must be left between the neck of the ramus and what formerly was the glenoid fossa (Fig. 7). If the coronoid process is involved, a sufficient amount of it must be removed to permit free motion. This can be done by working forward through the same exposure. No fascia, fat, membrane, or foreign material of any kind is placed between the end of the mandible and the temporal bone. When the bone is removed and motion secured, the wound is closed.

If, after the completion of the arthroplasty, sufficient motion has not been obtained, in a case in which there is no facial deformity and in which it has not been possible definitely to determine the side chiefly affected, the surgeon is forced to conclude that the other side is at fault, in which case the second side should be operated on later. On the other hand, occasionally after the removal of bone, the amount of motion obtained has been disappointing, though there has been no question but that the side operated on was the affected side. In such a case the trouble is in the muscles and peri-articular structures. Too vigorous attempts to open the jaw widely with the mouth gag or the threaded block of wood, are to be condemned for the teeth are often broken needlessly. By patiently forcing the mouth open each day with a mouth spreader, motion will steadily improve. The patient himself uses this spreader. He is encouraged to chew gum and thoroughly to chew meat, preferably tough meat, at his meals (Figs. 8, 9, 10 and 11).

RESULTS

Nearly all the 15 patients on whom arthroplasties were performed have done well. During the last three years in all the cases, which include ten articular and two articular-

Fig. 11. Note the threaded top used to separate the teeth after operation.

extra-articular, from one inch to one and three-quarters inches separation between the teeth with good free movement has been obtained. In some of the earlier cases the results were not quite so good. With improvement in technique the results have been better. As applied to our entire group of cases the operation described has been uniformly satisfactory.

In the articular-extra-articular cases equally satisfactory results have been obtained, although the scarring in the muscles has prevented the wide separation that was obtained in the others. In all of these cases, however, there is at least 1 inch separation between the teeth.

The extra-articular cases present a different problem; they are not benefited by the operation under discussion and our best results have been obtained by forcible stretching under ether.

CONCLUSIONS

We believe that the essential points in this method of treating articular ankylosis are:

1. Removing sufficient bone to make a space one-half an inch between the skull and the ramus and thus obtaining a stable functionating joint.

2. An incision that gives good exposure to the joint and does not injure the facial nerve.

3. Approaching the joint from above by removing part of the zygoma.

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THE RÔLE OF ASCARIASIS IN GALL-BLADDER DISEASE

By J. AVILES, M.D., F.A.C.S., San Juan, Porto Rico

THE ascaris lumbricoides is found in almost every part of the world except perhaps Iceland. The most common host of the parasite is man; its life history begins immediately the ova are ingested; and it occupies the upper part of the small intestine. Usually no more than one or two are present, but they may occur in large numbers. Raines (1) describes the unique case of a child of 20 months who discharged 834 worms in one day, 634 the next day, and within a short period 1992.

The pathogenic power of the ascaris lumbricoides depends upon the following factors:

1. In all probability a toxin. Herrick (2) produced a remarkable eosinophilia by the intraperitoneal injection of an aqueous extract of ascaris lumbricoides and demonstrated that the substance producing such an eosinophile increase was a protein. Flury (3) has shown that the tissues and excreta of this worm contain numerous compounds capable of inducing local hyperæmia, inflammation, and necrosis.

2. Migration of the parasite. In this way, the micro-organisms are carried from their habitat — the small intestines — to other parts of the body, causing infections. Infection is especially common when the parasite migrates to the bile-passages.

3. Mechanical disturbances. The recorded cases of mechanical lesions caused by the parasite, demonstrate that the worm is a potential factor in the production of dangerous complications. Although such lesions are rare, Kemp (4) cites cases of fatal asphyxia by the entrance of the worm into the larynx, or into the trachea and lungs causing gangrene. They have perforated intestinal ulcers, and some claim that even the healthy bowel wall has been perforated by them. Appendicitis has been attributed to the ascaris, and obstruction of the bowel is said to have been produced by an accumulation of a large number of ascarides.

Twenty cases (5) are on record in which round worms have entered the urinary passages, nine cases the pancreatic duct, and over ninety cases the bile-ducts. The literature (6) mentions a few cases where the parasite migrated into the gall-bladder.

Tonnelé (7) has found an ascaris partially in the common duct and partially in the duodenum, without causing any symptom during life, and at autopsy disclosing no signs of inflammation or biliary stasis. Nevertheless, it must be admitted that in this latter condition, the worm found in the common duct was there for a short time only. Under the same conditions, symptoms of inflammation of the biliary passages have arisen during life. Lieutaud (8) reports a case of a boy of fourteen years, who was seized by hepatic, colic-like pains, tenderness over the epigastrium and hepatic region, high fever, accompanied at the same time with salivation and icterus. The fæces became colorless, the pulse intermittent. Death occurred after convulsions. At the autopsy, the liver was found to be yellow and swollen, the gall-bladder very distended with bile, the ductus choledochus obstructed by a large ascaris lumbricoides. The stomach and intestine contained many entozoons of the same species. Bounapart (9), of Pisa, reports a case of icterus, which ended fatally, the cause of the death being the presence of an ascaris lumbricoides in the common duct.

The round worms are found more frequently in the gall-bladder, hepatic duct, and its branches inside the liver, than in the ductus choledochus. In many instances (10) they have been found in great numbers, giving symptoms of biliary stasis, dilatation, catarrhal inflammation, and sometimes ulceration of the ductus and suppuration of the liver. Exceptionally, there have been found dead, shrunken ascarides lumbricoides, forming the nucleus of biliary calculi.

Lorry (11) found in the gall-bladder of an insane patient who had been seized with convulsions, three large ascarides lumbricoides.

The patient had vomited one entozoon of the same species before death. Block and Heaveside have seen parasites isolated in the same organ. Cruveilhier (12) observed in a woman who died of pneumonia, two large ascarides at the bifurcation of the hepatic duct, and three more in its branches. The autopsy revealed no lesions in the liver, and during life no symptom was noticed which would lead one to suspect the presence of these parasites in the biliary passages. Guersant (13) cites the case of a child, suffering with mild colic-like pains, who died suddenly with convulsions. The autopsy demonstrated no pathology, except the presence of two ascarides lumbricoides about 7 to 8 inches in length in the hepatic duct and its branches. Broussais (14) relates the case of a soldier who died after fifteen days of illness. He had suffered with pain over the epigastrium and hepatic region, high fever, nervousness, icterus, convulsions, etc. The autopsy revealed a large ascaris lumbricoides in the common duct, and another smaller one in one of the branches of the hepatic duct. Rupture of the ductus choledochus has been caused by these worms. A collection at Vienna has one specimen of this kind. Fontaneilles (15) and Lorrentini (16) have reported some observations of the same character. There have been found lumbricoides inside the liver, in smooth round cavities, without any signs of suppuration; in other instances, there have been found rugosity and ulceration of the cavities. These cavities are formed partially by the dilatation of the ducts; the parasites by entwining and matting together forming the contents. Laeunée (17) has reported the case of a child two and a half years old in whom the biliary ducts were found very much dilated and full of ascarides lumbricoides, with no bile, the mucous membrane reddened, and in some spots ulcerated, and completely destroyed in others; the ascarides, therefore, were in immediate contact with the parenchyma of the liver. Many cavities formed in this way were the size of an almond. Kirkland (18) cites a case observed by him in which an abscess opened through the skin, at the right costal margin of the false ribs, giving exit to a lumbricoides. Afterward, a biliary fistula was established, proving that the helminth came from the bile ducts. The history of our case is as follows:

The patient was a female of 38 years, married, the mother of five children. The menstrual periods had been normal, and there had been no abortion. The patient says that since she was twelve years of age, she has been suffering from attacks of colic-like pain over the right upper quadrant of the abdomen, and she occasionally vomited stomach secretion mixed with bile. She has expelled, in some occasions, round worms with the vomiting, and in one instance, the vomiting of an ascaris, relieved the pain. The attacks of pain have been more frequent since last December, and for six days have been continuous and very painful. She complains of some kind of soreness over the chest, and difficulty in respiration during attacks of colic.

She was admitted to the Municipal Hospital, December 31, complaining of very acute pain over the epigastrium and hepatic region, radiating to the back and left shoulder, tenderness along the right costal margin, slight icterus, moderate fever, pulse 102. Urine examination: no albumin, no sugar, no casts; biliary pigments present.

A probable diagnosis of cholecystitis with calculi was made.

Operation: The gall-bladder was found much distended, with no adhesions whatever. About five ounces of bile was aspirated. Cholecystotomy was performed. The walls of the bladder were hypertrophied, but no rugosity of the mucosa was evident. We did not find any calculus, but a big ascaris lumbricoides about 8 inches in length, partially obstructing the cystic duct. The operation was completed by draining the gall-bladder. The patient made an uneventful recovery and all the symptoms existing previous to the operation, disappeared. Antihelminthic remedies were administered during the convalescent period.

CONCLUSIONS

Our conclusions are:

1. The diagnosis of gall-bladder or of biliary duct disorders due to migration of ascarides lumbricoides, is not easy.

2. Such disturbances are rare. At times the prognosis is grave and in some instances cases end fatally in a very short time. In others, death comes suddenly.

3. An individual who is seized with hepatic colic-like pain, accompanied with vomiting of ascarides lumbricoides, has the syndrome necessary for suspecting that the case is one of migration of the parasite or parasites into the biliary ducts or gall-bladder; and unless

the symptoms subside, surgical intervention is indicated.

4. Antihelminthic remedies must be administered as a prophylactic measure, in those cases in which a history of ascariasis accompanies disorders of the gastrohepatoduodenal system.

5. In those cases in which surgical intervention has been practiced, antihelminthic remedies must be given to avoid new serious complications.

The main object of this article is to add my case to the very few found in the literature on ascaris lumbricoides, the etiology of which is found in another pathological entity, ascariasis.

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THE DIAGNOSIS OF URETERAL CALCULI[1]

By DANIEL N. EISENDRATH, A.B., M.D., F.A.C.S., Chicago

THE personal observation of nearly forty cases has convinced me that but little reliance is to be placed upon clinical symptoms in the diagnosis of ureteral calculi. The syndrome known as renal colic with its radiations of pain to the testis and lower urinary tract was formerly regarded as almost pathognomonic of ureteral lithiasis. Further experience has shown that any lesion which will suddenly cause an increase in intrarenal tension will give rise to the identical group of symptoms. Typical renal or more correctly ureteral colics are now known to be present: (a) when particles of tumor mass escape into the ureter; (b) when blood-clots or pus detritus is passed from the renal pelvis into the ureter; (c) in cases of renal or ureteral infection; (d) in nephritis; (e) in appendicitis when the ureter is in close proximity to the inflamed appendix; (f) in tabes; (g) in strictures of the ureter whether of congenital or acquired origin; (h) in kinking of the ureter as observed in cases of movable kidney or compression of the ureter[2] by an accessory artery to the lower pole of the kidney. Nor does the symptom of fixed pain over the kidney or along the course of the ureter fare any better. In a recent analysis of the symptoms of a large number of cases of ureteral calculi from the Mayo Clinic, Braasch and Moore[3] found that pain was referred largely to the kidney in 67 per cent, to the upper abdominal quadrant in 15 per cent, and to the region of the lower ureter or bladder in eleven per cent. No definite radiation of pain was observed in 5 per cent, and no pain whatever in 2 per cent. We thus see that the symptoms of a fixed pain in ureteral calculi independent of colicky attacks is distributed over such a wide area in the abdomen that there is no characteristic localization or radiation. The fact that ureteral calculi can be present for many years without giving rise to any symptoms at all,

[2] I have recently reported a typical example of such a cause of ureteral colics (Surg. Clinics, Chicago, Vol. 2, p. 95).

[3] J. Am. M. Ass., 1915, lxv, 1234.

[1] Read before the Chicago Surgical Society, April 5, 1918. (For discussion, see p. 542.)

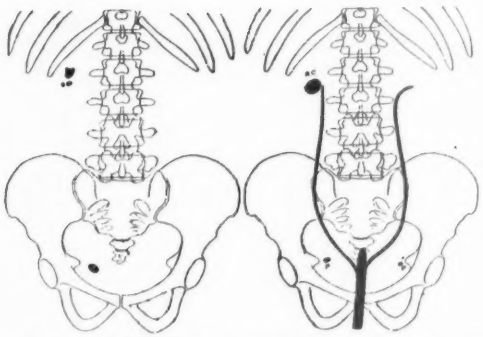

Fig. 1 (at left). X-ray tracing of combination of true renal and extra-ureteral shadows (Case 1). In the right renal pelvis three calculi were found (upper three shadows) and on the same side an extra-ureteral shadow was seen and proved to be a calcified nodule in the right ovary.

Fig. 2. X-ray tracing from Case 2 with true right renal calculus shadow, *R. C.*, and two extra-ureteral pelvic shadows, *P.* Note relation of shadows to X-ray catheter.

makes it incumbent upon us to study the urinary tract in every thorough examination of the abdomen, especially when there is a history of colics, fixed or radiating pain or of microscopic or macroscopic hæmaturia. It is only through the employment of some or all of the methods of diagnosis which have been developed in the special field of urological surgery in the past ten years, that we are able to differentiate the various diseases of the urinary tract which can give rise to symptoms identical with those of ureteral calculi. The chief object of this paper is to make a plea to my surgical colleagues for the more frequent use of the modern methods of diagnosis of ureteral lithiasis, such as the X-ray study of the urinary tract with the aid of (a) the shadowgraph catheter, (b) ureterography or pyelography; (c) stereoscopic plate method; (d) the results obtained by cystoscopy and ureteral catheterization, and finally, (e) intensification of suspicious shadows.[1]

I have had no experience with the use of the wax tipped catheter,[2] so am not prepared to give an opinion as to its value as a diagnostic aid in ureteral calculi. To demonstrate the necessity of the more or less routine use of four of the five special methods just mentioned in the differential diagnosis of ureteral calculi, I desire to report some typical cases.

[1] Kuemmel was the first to suggest the intensification of faint shadows of calculi in the urinary tract. The method consists of injecting a very small quantity of some solution similar to those used in pyelography into the ureter through a catheter lying in close proximity to the suspected shadow. The calculus will retain some of the solution on its surface and a second X-ray plate taken after such an injection will show a distinct shadow where previously there had only been a faint one.

[2] In the female, Kelly, Hunner, and Geraghty believe that the wax tipped catheter is of great aid. Hinman recently suggested a method of application of the wax tipped catheter in the male.

Shadows Within and External to the Urinary Tract

Combination of True Intrarenal and Pelvic Exta-ureteral Shadows

Case 1. Female, age 30, with history of pain over kidney of many years duration. The X-ray showed several shadows apparently within the pelvis of the kidney and a shadow in the pelvis on the same side as the renal shadow. No X-ray catheter was employed to differentiate shadows as to whether they were within or external to the urinary tract. Operation revealed calculi in the renal pelvis, but exploration of pelvic portion of ureter showed that lower shadow was due to a calcareous nodule in ovary. If the X-ray catheter and other differential diagnostic methods had been employed, exploration of pelvic portion of ureter would have been unnecessary. A study of the X-ray plates after operation also showed that the lower shadow was not of uniform density as is true of renal or ureteral calculi, and this alone should have made us suspicious that the shadow was extra-ureteral (Fig. 1).

Case 2. Male, age 25, with history of long standing pain over kidney region with occasional passage of blood. X-ray plates showed (Fig. 2) one large round shadow of uniform density in right kidney region, and two small round shadows on either side of the true pelvis along the course of the pelvic ureter. The latter two shadows were at first thought to be ureteral calculi, but upon taking another set of plates with an X-ray catheter inserted into each ureter it was evident that the upper shadow in the kidney region was intrarenal but that the other two shadows were due to phleboliths, that is, extra-ureteral.

Both of these cases show the necessity of not arriving at a hasty conclusion that, because the patient has a shadow within the urinary tract, other shadows must also be shadows of a true intrarenal or intra-ureteral character.

How Typical History and Apparently Intra-ureteral Shadow May Lead to Wrong Diagnosis.

Case 3. Male, age 64. Onset one year before with pain over left iliac region radiating toward bladder. The X-ray showed a relatively large oval, and a small round shadow along the course of the pelvic ureter on the left side. On account of the presence of pain over the course of the left ureter

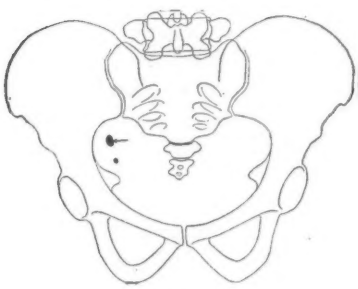

Fig. 3

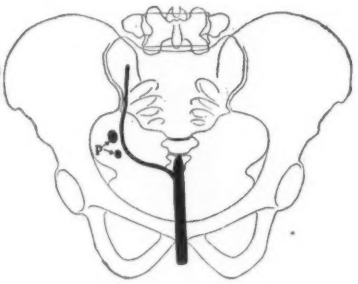

Fig. 4

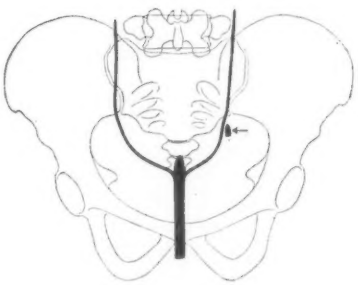

Fig. 5

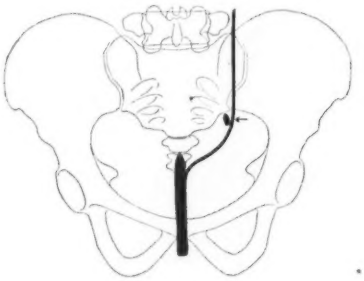

Fig. 6

Fig. 3. Case 3. Oval shadow thought to be intra-ureteral because of typical right-sided symptoms. Passage of X-ray catheter thought not to be necessary. At operation found to be extra-ureteral. (See Fig. 4.)

Fig. 4. X-ray tracing of Case 3 after passage of shadowgraph catheter showing shadows to be extra-ureteral; phleboliths, *P*.

Fig. 5. X-ray tracing of Case 4 showing extra-ureteral location of shadow. Compare with Fig. 6.

Fig. 6. X-ray tracing of Case 4 showing how shadow seemed to be tilted by X-ray catheter at second introduction. Compare with Fig. 5.

and the oval shape of the upper shadow (Fig. 3) the passage of an X-ray catheter was thought to be superfluous. At operation two large calcareous plaques were found in branches of the internal iliac vessels immediately adjacent to the pelvic portion of the ureter.

This case emphasizes the fact that no matter how typical the history or the shape of the shadow, we could have avoided an operation in this case had we taken the trouble to use the differential diagnostic measures which are now generally accepted as being necessary in such cases, namely, passage of X-ray catheter, ureterography and stereoscopic X-ray plates. Although we felt before operation that the lower shadow, because it was so distinctly round in outline, must surely be a phlebolith, the oval character of the upper shadow greatly resembled that of many ureteral calculi. An X-ray catheter passed after operation showed the shadows to be extra-ureteral (Fig. 4).

CASE 4. Female, aged 60. Principal symptom pain in pelvis, especially upon urination. An X-ray taken by an expert radiographer in her home city showed a large triangular shadow on the right side of true pelvis. The diagnosis made by her physician was ureteral calculi. Urine from right ureter showed a few pus cells. In order to avoid an error in this case, in spite of the fact that the shadow being triangular did not resemble that of calcareous deposits in an extra-ureteral stricture, we introduced an X-ray catheter into the right ureter and this showed a distinct space between the catheter and the shadow (Fig. 5). We also concluded because of the irregular density, that is, alternating darker and lighter areas in the shadow, that it was a calcified pelvic lymph gland. Further study of the X-ray plate with the shadowgraph catheter *in situ* made us feel, however, that such a triangular shadow

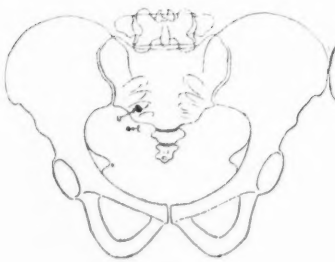

Fig. 7

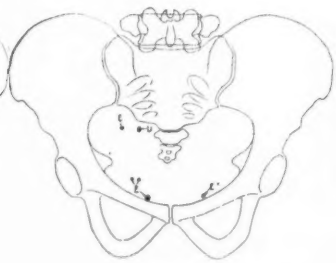

Fig. 8

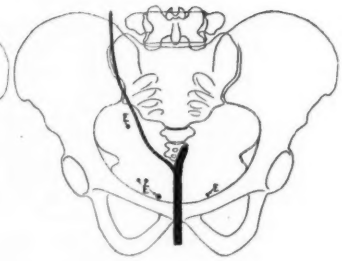

Fig. 9

Fig. 7. Tracing of X-ray plate from Case 5 showing how shadow of calculus *U*, may lie over sacrum. Another instructive feature of this case was the fact only one extra-ureteral *E*, shadow was to be seen because the pelvis was not tilted enough in taking the picture. Compare with Figs. 8 and 9.

Fig. 8. Tracing of X-ray plate from Case 5 taken with pelvis tilted. Note the unusually large number of round extra-ureteral shadows, *E*, to be seen in this plate as compared with the one taken without tilting the pelvis (see Figs. 7 and 9). Note how the shadow of the calculus, *U*, has been brought away from sacrum by tilting pelvis. (See Fig. 7.)

Fig. 9. Tracing taken from X-ray plate of Case 5, following the passage of calculus after injection of albolene into ureter. Note the absence of the true ureteral calculus shadow, *U*, seen in Figs. 7 and 8. Note the constant presence of the many extra-ureteral shadows *E*.

could not be extra-ureteral, and we introduced an X-ray catheter a second time and this apparently tilted (Fig. 6) the shadow in such a manner as to lead us to believe that it was intra-ureteral. At operation a calcified nodule about the size of a split pea was found lying just external to the juxtavesical portion of the right ureter.

In this case we were influenced in our judgment of the extra-ureteral character of the shadow by the fact that the X-ray catheter apparently caused a change in position of the shadow. Had we employed the two additional methods to be referred to a little more in detail later, namely, ureterography and a stereoscopic X-ray, we would have avoided an error in this case.

COMBINATION OF TRUE INTRA-URETERAL AND EXTRA-URETERAL PELVIC SHADOWS

CASE 5. Male, age 40, with history of repeated severe right ureteral colic accompanied by hæmaturia. The first X-ray was taken with the pelvis tilted but little and when the plate was studied it was seen that one shadow (Fig. 7) was obscured by lying over the shadow of the sacrum. This observation shows the advisability of studying our X-ray plates of the urinary tract when they are dry, and to note whether shadows lie over the pelvic bones, a condition to which Cabot was the first to call attention. The second X-ray plate showed a much larger number of shadows, some of which had been obscured by a shadow of the anterior of the bony pelvic ring before the pelvis had been tilted. A number of these shadows were typically round in character and were readily recognized as phleboliths (Fig. 8), that is, extra-ureteral. The shadow which in the first X-ray plate had been obscured by that of the sacrum was shown in the second plate to be free of the sacrum (Fig. 8). The history of repeated colic and the presence of blood in the urine, both macroscopically and microscopically, made us feel, however, that one of the shadows must be due to a calculus lodged in the pelvic portion of the ureter. A plate was not taken with an X-ray catheter *in situ* before nonoperative measures for removal of the calculus were instituted. One ounce of albolene was injected into the right ureter and was soon followed by the passage of a small calculus of the uric acid type. The X-ray taken about two weeks after the passage of this calculus showed that one of the shadows, namely the one (Fig. 9) which in the first plate had been obscured by the sacrum, and in the second one was seen to lie free of the bone, must have been an intra-ureteral shadow due to the calculus which the patient passed because all of the extra-ureteral calculi were still to be seen, but this one was absent.

This case shows that both intra- and extra-ureteral shadows may be present in the pelvic portion of the ureter, and their nature can only be ascertained with certainty by the use of the three differential methods frequently mentioned in this paper. Had we taken a stereoscopic X-ray with a shadowgraph catheter *in situ* supplemented, perhaps, by ureterography, we would have had no difficulty in differentiating this extra- from the intra-ureteral shadows.

CASE 6. Extra- and intra-ureteral pelvic shadows. The diagnosis was made by X-ray catheter, ureterogram, and stereoscopic plates. Male, aged 39, had two attacks of hæmaturia without other

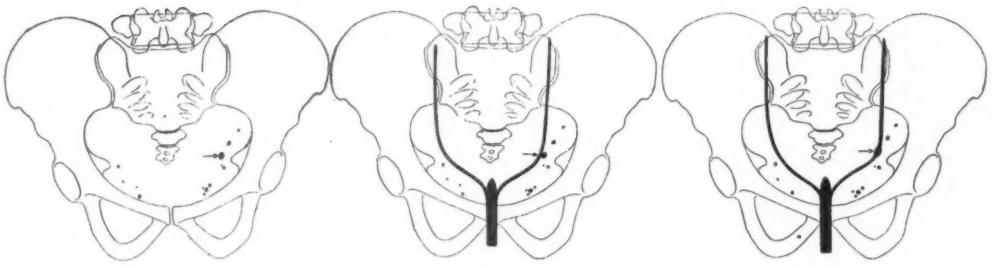

Fig. 10 Fig. 11 Fig. 12

Fig. 10. X-ray tracing of Case 6 showing presence of extra-ureteral and intra-ureteral shadows. (Compare with Figs. 11 and 12.)

Fig. 11. X-ray tracing of Case 6 showing all shadows seen in Fig. 10 to be extra-ureteral except one to which arrow points. This shadow was shown to be intra-ureteral by ureterogram (Fig. 12) and stereoscopic roentgenography.

Fig. 12. X-ray tracing of Case 6 after introduction of argentide into ureter. Note nodular dilatation at location of the intra-ureteral shadow seen in Fig. 11.

symptoms referable to urinary tract. The X-ray showed a large number of shadows on both sides of true pelvis (Fig. 10). Cystoscopy and ureteral catheterization as well as pyelography failed to reveal the presence of any inflammatory lesion in the urinary tract. The X-ray catheter showed that one of the many pelvic shadows was in contact with the X-ray catheter (Fig. 11). In order to confirm the fact that this shadow was intra-ureteral, i.e., due to a calculus, stereoscopic plates were made and also some argentide solution permitted to flow through the ureteral catheter. This latter diagnostic method showed a characteristic nodular dilatation (Fig. 12) opposite the calculus. The stereoscopic plates also confirmed the intra-ureteral character of the shadow.

The use of all three of these methods in any case of suspected ureteral calculus is of the greatest value in cases where the shadow lies in the true pelvis. I can fully endorse the statement made by Hyman in a recent article[1] to the effect that "these three procedures, the use of the opaque catheter, stereoroentgenography and ureterography enable us to reduce the possibility of error to a minimum." Hyman believes that of the three methods, the most reliable and valuable is stereoroentgenography with the catheter *in situ*.

DIFFERENTIATION OF SHADOWS IN COURSE OF UPPER URETER

The employment of the X-ray catheter combined with ureterography or pyelography is of the greatest value in order to differentiate shadows due to extra-ureteral conditions such as calcified lymph glands, gall-stones and other lesions giving rise to shadows along the course of the iliac and lumbar portions of the ureter. The following two cases will serve to demonstrate the great value of these two methods:

[1] Med. and Surg., 1917, i, 343.

CASE 7. Shadows of calcified lymph glands from those of ureteral calculi. Male, age 63. History of increased frequency and painful urination for several months. He had several attacks of severe pain in the right iliocostal space radiating upward and accompanied by chills and fever. The X-ray showed a number of shadows just above the crest of the ilium on the right side. On account of the variation in density of the individual shadows, they were thought to be extra-ureteral (Fig. 18) and this was confirmed by passage of the X-ray catheter which showed them to be separated from the opaque catheter by a clear space.

This alternation of darker and lighter areas in the shadow is according to my observation quite characteristic of calcified lymph nodes.

CASE 8. Differentiation of gall-stones and ureteral calculus. Male, age 30, operated on for gall-stones one year before onset of present illness. Gall-bladder removal followed by uneventful recovery. One year later pain of a colic-like nature in right upper abdominal quadrant, thought at first to be due to recurrence in biliary tract. The X-ray showed an oval, long shadow, of uniform density (Fig. 13) along the course of the common duct but the passage of an X-ray catheter confirmed the intra-ureteral character of the shadow as that of calculus in the upper portion of the lumbar ureter (Fig. 14). Removal of this calculus at later date. The uniform density was the first indication that the shadow could not be a gall-stone because in the latter the shadow usually has a dark periphery and a lighter center.

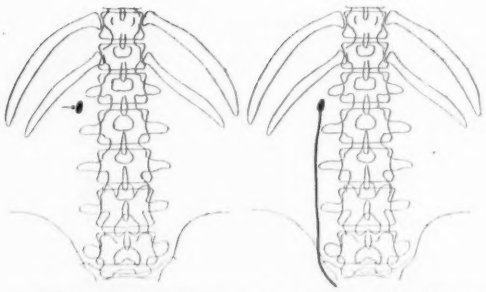

Fig. 13 (at left). X-ray tracing of shadow in lumbar portion of the right ureter (Case 8). Pain simulated that of recurrence of symptoms one year after cholecystectomy. (Compare with Fig. 14.)

Fig. 14. X-ray tracing of same case shown in Fig. 13 after passage of X-ray catheter. This confirmed intra-ureteral nature of shadow.

INTENSIFICATION OF WEAK SHADOWS. CONSIDERATION OF VALUE OF X-RAY

When we recall the fact that a fairly large percentage of ureteral calculi are of the pure uric acid type, it is easy to understand why the shadows should often be overlooked because they are so very light and hard to distinguish from the background. I can warmly recommend a method first suggested by A. D. Bevan of Chicago, of studying our plates when they are perfectly dry and preferably with an opera glass which concentrates the view to a small field at a time and gives one a stereoscopic effect. Braasch is of the opinion that an accurate diagnosis of stone in the ureter cannot be made from roentgenographic data in more than 60 per cent of the cases. In 67 cases reported by Geraghty and Hinman[1] the X-ray missed a calculus in 15, or 24.4 per cent, most often in the lower ureter.

A recent experience with a method first suggested by Kuemmel has led me to urge its more frequent use in cases where the presence of a calculus is suspected, but the X-ray either is negative or shows a very faint shadow.

CASE 9. Male, age 40. Four typical attacks of right ureteral colic with microscopic hæmaturia. The X-ray showed a faint shadow in the course of the right ureter (lumbar portion). The X-ray catheter passed and a small amount of collargol (10 per cent) was permitted to enter the ureter in the vicinity of the shadow through the catheter. A second X-ray plate now showed distinct shadow just beyond tip of X-ray catheter (Fig. 19). Removal of rough uric acid calculus from lumbar portion of the right ureter.

The plan of the Kuemmel method is to intensify the shadow by permitting some of the solution impervious to the X-ray to be deposited on the surface of the calculus, thus

[1] Surg., Gynec. & Obst., 1915, xx, 515.

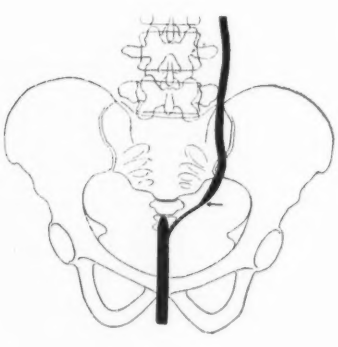

Fig. 15

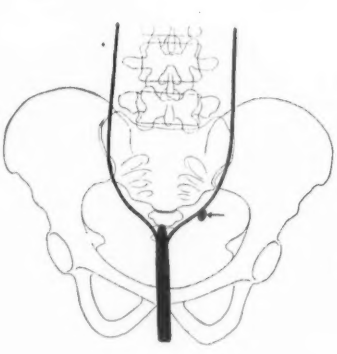

Fig. 16

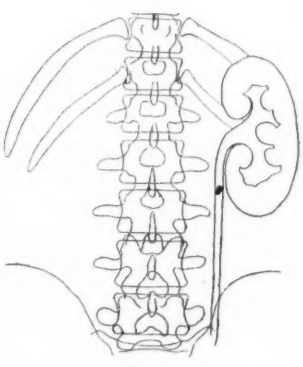

Fig. 17

Fig. 15. Tracing of X-ray plate after use of argentide from Case 10 with cystoscope and X-ray catheter in place showing dilatation of ureter above calculus. Arrow points to location of calculus. Note wide shadow above calculus due to dilated ureter. (See Fig. 16.)

Fig. 16. X-ray tracing of Case 10 showing shadow of left ureteral calculus to be in immediate contact with shadowgraph catheter. In order to confirm intra-ureteral nature of shadow, a ureterogram was made. (See Fig. 15.)

Fig. 17. X-ray tracing Case 11 showing location of calculus impacted in lumbar ureter. Presence not suspected before operation.

Fig. 18. Typical extra-ureteral shadows of calcified retroperitoneal glands in Case 7. Note dark center and light periphery of the irregular shadows.

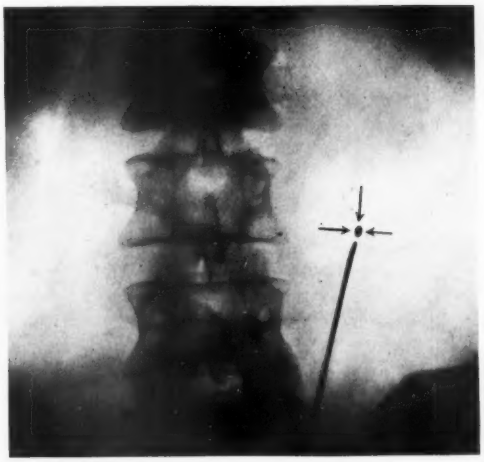

Fig. 19. Intensification of shadow in Case 9. Before the use of the X-ray catheter and collargol, the shadow could hardly be seen.

increasing the density of the shadow. I can warmly recommend this method in doubtful cases. I have had so little personal experience with the wax-tipped catheter for the diagnosis of such difficult cases that I can only quote from the above referred to article of Geraghty and Hinman, and a more recent one by Hinman[1] in which they state that they have made a diagnosis by the use of the wax-tipped catheter in a number of cases in which the X-ray was negative, the diagnosis being confirmed in every case by the operative removal or subsequent passage of the stone.

Value of Ureterography and Pyelography in Recognition of Intra-ureteral Shadows and Degree of Obstruction of Ureter and Secondary Effects on Kidney

Those who have hesitated to employ this most valuable method of diagnosis on account of the early fatalities following its use, are urged to renew their acquaintance with the assurance that the work of the writer[2] has shown experimentally and its employment in thousands of cases by Braasch (1) and others has demonstrated that ureterography and pyelography have been placed upon a safe basis. The information obtained by this method is of especial value in the recognition of the presence of a calculus either by a localized dilatation (Fig. 12) at the point of lodgment of a calculus or by the estimate of the degree of dilatation of the ureter or renal pelvis above the calculus.

The following case will serve to show the value of the method both for diagnostic and prognostic purposes:

Case 10. Male, age 33. History of repeated left ureteral colics over period of two and one-half years. X-ray showed relatively large shadow in juxtavesical (Fig. 15) portion of the ureter, confirmed by introduction of X-ray catheter. Urine escaping through left ureteral catheter was very turbid, and contained many pus-cells. In order to confirm the fact that the shadow was due to a calculus and also to ascertain the condition of the ureter and renal pelvis above the calculus, a ureteropyelogram was made. It revealed a shadow (Fig. 16) about one centimeter wide indicating a moderate degree of obstruction. The pelvic shadow confirmed this showing only a slight amount of dilatation. After a number of ineffectual attempts at nonoperative removal, the calculus was removed and at operation the size of the ureter confirmed the ureterogram in

[1] Calif. St. M. J., 1917, xv, 392.
[2] J. Am. M. Ass., 1915, lxiv, 128.

showing that the ureteral walls were not hopelessly thinned out as the result of the long-standing obstruction. The urine became entirely clear shortly after the removal of the calculus.

Increasing experience strengthens the opinion not only of myself but of many others that ureterography and pyelography are perfectly safe methods if the fluid is allowed to run in by gravity and that these two applications of the method have greatly increased our diagnostic resources.

Necessity of Routine X-ray Examination in Cases of Urinary Infection

Case 11. Male, age 50, was operated on five months before admission for acute gangrenous appendicitis. The onset was sudden and accompanied by chills, fever, and pain on urination, five days before admission. There were no localizing signs but the history showed that 14 years before he had had a left ureteral colic with hæmaturia and the passage of a calculus. The temperature at the time of first being seen varied between 102° and 103° and was of continuous type. No apparent cause was to be found for this fever until an X-ray (Fig. 17) of the urinary tract was taken and showed a shadow due to calculous obstruction in left ureter close to the kidney. At operation a calculus was found at the location indicated, and the kidney was so intensely infiltrated that it required removal. Uneventful recovery.

This case illustrates a fact which experience with a number of similar cases has taught me; namely, that an X-ray of the urinary tract should be taken as a routine measure in every case of infection of the urinary tract with the exception of those cases of pyelitis of pregnancy and puerperium where the etiology of the infection is quite evident.

Conclusions

1. The clinical history cannot be absolutely relied upon to make a diagnosis of ureteral calculi since there are many other conditions giving rise to ureteral colic which must be excluded.

2. The presence of a shadow along the course of the ureter does not necessarily mean a calculus.

3. The three best methods to determine whether the shadow lies within or external to the ureter are the X-ray catheter, ureterography, and stereoroentgenography. The last named is the most reliable and should be employed if possible in every case.

SUBDIAPHRAGMATIC OR PHRENIC ABSCESS[1]

By EMANUEL FRIEND, M.D., F.A.C.S., Chicago

ONE of the most interesting, and at the same time difficult problems in surgical diagnosis is that of the above-named dangerous affection. Difficult as this diagnosis is today, it was much more so years ago before the advent of such aids as asepsis, hæmatology and roentgenology. It has been my good fortune to see and examine a number of such cases in my surgical service at the Michael Reese Hospital, and I shall base my conclusions on these in particular, two of which I shall detail here. This is also a good place to generalize regarding the qualifications of the surgical specialist, namely, that which I have always contended, the best specialist is the one who has had a general training. In no class of cases is this so apparent as in this class. I mean to imply that the diagnosis calls for a good knowledge of physical diagnosis of the chest and abdomen, auscultation, percussion, etc.

Senn, on page 904, *Practical Surgery*, under subdiaphragmatic peritonitis, defines the same as a peritonitis limited to the under surface of the diaphragm and any of the adjacent abdominal organs. If the inflammation remains limited and life is sufficiently prolonged, it usually terminates in the formation of a subdiaphragmatic or subphrenic abscess. Perforating ulcer of the stomach and duodenum, and abscess of the spleen and liver are the most frequent affections that precede the same.

Maydl has written the most complete

[1]Read before the Chicago Surgical Society, April 5, 1918. (For discussion see p. 540).

Fig. 1. Case 1. Roentgenogram taken October 28, 1915.

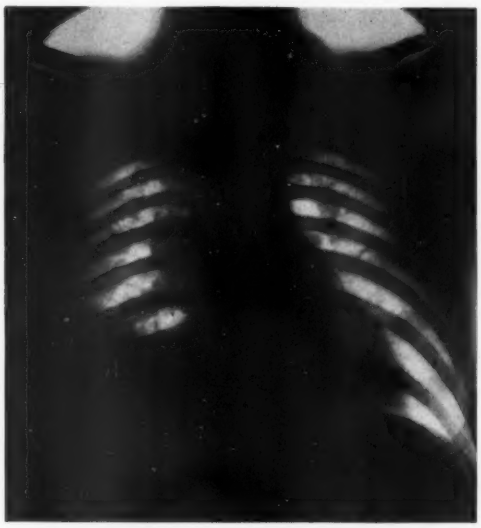

Fig. 2. Case 1. Roentgenogram taken November 16, 1915.

treatise on subphrenic abscesses, dividing them into twelve groups, according to their locations and the organ from which they have their starting point. The diagnosis is usually difficult and Maydl recommends the exploring needle very strongly, as an important diagnostic resource. Maydl has shown that out of 104 cases not operated on, only 6 recovered, while out of 18 cases operated on, 11 per cent died.

DIAGNOSIS

The cardinal points in diagnosis I have found to be as follows:

1. Temperature, ranging from subnormal to anywhere from 101° to 106°, usually preceded by a chill and sweating, with or without a previous history of an acute suppurative process elsewhere.

2. Pain in the neighborhood of the pus accumulation, or it may be diffused over the entire upper abdomen, increased on deep inspiration.

3. Tenderness may be present or absent over the affected area.

4. Phrenic pain, supraclavicular on the affected side.

5. Pleurisy with effusion on the affected side, easily demonstrated with the exploring needle.

6. High leucocyte count, ranging from twelve to forty thousand.

7. X-ray findings are those usually of an uneven level of the diaphragm on both sides; in other words, a marked bulging upward on the affected side with an acute costophrenic angle, together with a marked shadow over the pus accumulation, and a shadow distinctly less between the accumulation and the diaphragm caused by gas when the causative agent is the colon bacillus. Naturally the symptoms depend upon the localization of the abscess, the possibilities as to situation being: right retroperitoneal, left retroperitoneal, right anterior intraperitoneal, left anterior intraperitoneal, right posterior intraperitoneal, left posterior intraperitoneal.

A valuable aid in determining the extraperitoneal location is the inflation of the colon with air.

An abscess beneath the diaphragm, between it and the liver, may be either intra- or extraperitoneal as already stated; it may lie to the right or to the left of the suspensory ligament of the liver. The intraperitoneal is decidedly more frequent than the extraperitoneal, and the abscess is more commonly found upon the

right side. The upper and posterior surfaces of the liver are partly covered by peritoneum and partly devoid of any serous covering. The suspensory ligament forms an oblique partition, dividing the liver into a larger right and a smaller left portion. An abscess which lies to the right of the falciform ligament begins generally in inflammation affecting the gall-bladder, the liver, the kidney or the appendix. An abscess which lies to the left of this ligament starts in the majority of cases from a perforating ulcer of the stomach or duodenum, or from inflammation in the pancreas, intestines, spleen or left kidney. The commonest source of infection is undoubtedly the appendix. In a series of 179 cases of Maydl's subphrenic abscess, the alimentary canal was the starting point of the disease in 73 cases. Koerte has reported a series of 60 cases upon which he had operated, 40 cases recovering. The origin of the abscess was in the appendix in 27 cases. He gives the following table:

Source of Abscess	Cases	Recovered	Died
Appendix	27	18	9
Stomach	9	5	4
Duodenum	1	0	1
Spleen	5	3	2
Kidney	4	2	2
Pleura	4	3	1
Costal	2	2	0
Pancreas	1	1	0
Hydatid	3	3	0
Liver and gall-bladder	2	2	0
Undetermined	2	1	1
	60	40	20

The inflammation from the appendix may spread upward within the peritoneal cavity along the outer side of the colon, or it may pass upward in the loose cellular tissue behind the colon, or via the lymphatics or veins.

The diagnosis of subphrenic abscess is often difficult, especially if there be no free gas within the cavity, when there is serous or purulent fluid at the base of the right lung. The physical signs that may be elicited are the following. On the right side posterior there will be dullness at the base of the chest. If there be no free gas in the abscess, the liver dullness will merge above into the dullness produced by the overlying pus. The upper boundary of this dull area will be convex. The physical signs are, therefore, the same as in a case of abscess of the liver. When, however, gas is present within the abscess, the signs are most characteristics. Percussion reveals three zones of different resonance, one above the other. The upper is the normal resonance of the lung. In the middle there is tympany, due to the gas within the abscess. In the lower dullness, due to the fluid within the abscess. This latter dullness merges into the dullness of the liver.

Abscesses on the left side, coming as they do from the stomach or duodenum, contain gas. The physical signs are generally as just delineated.

When pleuritic effusion is present above the subphrenic abscess, four zones of varying resonance may be encountered. The upper is normal resonance, the next is a dullness due to pleuritic fluids; the next a tympany due to the gas of the abscess, and the lowest a dull area due to pus in the abscess cavity. An abscess on the right side may push the liver downward. When situated on either side the bulging of the chest wall or of the anterior abdominal wall may be seen.

Regarding the use of the exploring needle, I cannot emphasize too much the employment of a large caliber needle, due to the thickness of the pus in many cases and the presence of a thick tenacious layer of lymph on the upper surface of the liver.

OPERATION

There are four routes by which to approach an abscess of this kind: (1) by incision through the anterior abdominal wall, (2) by incision along the lower costal margin, (3) by incision through the chest wall and diaphragm, and (4) by a combination of the thoracic and abdominal incisions.

The third or transpleural operation is the one most employed. An incision five or six inches in length is made over the ninth or tenth ribs on the right side, and over the seventh and eighth on the left side. The middle of the incision is at the point from which pus has been withdrawn by the exploring needle. The ribs are exposed and about 3 or 4 inches of each are excised. The

condition of the pleural cavity is then determined. If it is empty or contains only clear fluid in small quantities, it must be protected from infection either by packing the wound tightly with gauze and postponing the completion of the operation for twenty-four hours, or by the introduction of sutures, which include the diaphragm and both layers of the pleura. After this a small amount of gauze is packed around the edges to form a barrier to prevent infection of the pleural cavity. The diaphragm is then incised, the cut edges seized with forceps and drawn forward, the cavity emptied, washed out gently and a large drainage tube inserted. Counter drains in the back may be necessary.

The histories of the cases referred to are as follows:

CASE 1. O. L., age 39, merchant, admitted to Michael Reese Hospital, October 10, 1915; discharged cured December 19, 1915.

Diagnosis. Acute, gangrenous, ruptured appendicitis; local peritonitis; right-sided pleurisy with effusion and subphrenic abscess.

History. The patient was seized with severe pain thirty-six hours before admission to the hospital, which at first was severe over the entire abdomen but within twenty-four hours became localized to the right lower quadrant. The patient had slight headache but no nausea or vomiting. His past history was negative.

Physical examination. The abdomen was slightly distended, symmetrical. There was marked rigidity over the right half of the abdomen. Tenderness was generalized, but especially severe over the lower right quadrant. The leucocyte count was 23,300. Pains radiated to the back. No mass was palpable.

Operation on the day of admission. Ruptured, retrocæcal appendix was found and drained.

The patient did well for a number of days and then developed a temperature ranging from subnormal to 103.6° F., with pains in the right hypochondrium, and supraclavicular pains on the right side. A subphrenic abscess was suspected, but aspiration revealed nothing. The X-ray findings, November 16, 1915, showed a bulging upward into the chest of the right diaphragm, and an acute costophrenic angle on this side. Fluoroscopically there was slight motion of the diaphragm on this side on inspiration. The liver shadow was unusually dense.

Laboratory findings. Urine contained albumin and acetone and an occasional red blood-cell, 8 to 10 to the high power field. Few epithelial cells present. White blood count varied from 28,000 to13,000.

Physical examination of the chest revealed fluid in the right pleural cavity which was tapped and about a quart of seropurulent fluid was withdrawn, which showed histologically many pus-cells, epithelial cells and red blood-corpuscles; streptococci, pneumococci, and staphylococci. The differential count showed 79 per cent polymorphonuclears, 19 small mononuclears, 1 large mononuclear, 1 transitional.

Fig 3. Case 2. Roentgenogram taken February 19, 1917.

On November 18, the ninth rib on the right side anteriorly was resected and a large subphrenic abscess was drained. Uninterrupted recovery.

CASE 2. M. S., age 52, a peddler, was admitted to Michael Reese Hospital, February 18, 1917.

History. Onset seventeen days prior to entrance to the hospital with pains in the epigastrium along the right costal arch radiating to the right shoulder. He suffered from weakness, anorexia, loss of weight, chills and fever.

On admission his temperature was 101.2° F., pulse 98, respirations 26.

Physical examination. An emaciated male, appearing very sick. Expansion of the right chest only fair. Dullness on percussion from the ninth to the twelfth rib. The abdomen was flat, no tender areas; no masses were palpable.

X-ray findings. Right diaphragm bulged high into the chest cavity, the outline was sharp, indicating pressure from below, and a very acute costophrenic angle was present. Fluoroscopically the excursion of the diaphragm was limited on this side.

Laboratory findings. Leucocyte count 21,800; urine, negative.

Diagnosis. Subphrenic abscess.

Operation. Resection of the eighth and ninth ribs anteriorly; a large abscess was discovered, opened, and drained.

A NEW PROCEDURE FOR THE LOCALIZATION OF URETERAL STONE

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ONE of the most trying problems that genito-urinary surgeons and radiographers are called upon to solve is that dealing with the correct interpretation of shadows occurring within the bony pelvis. Shadows of extra-ureteral origin are often confused with those produced by ureteral calculi and hence call for an accurate differentiation. The largest number of these shadows is due to extra-ureteral shadow-producing bodies and can be definitely excluded by employing the shadowgraph catheter, which shows that the suspicious shadows lie far away from the shadowgraph catheter. In cases of stone, in which the shadows and the catheter apparently lie side by side, the diagnosis has generally been fairly easy. Attention has been called to the value of the shadowgraph catheter in these instances.[1] In one instance, however, in which the diagnosis was based upon the fact that the shadow of the stone and the catheter were side by side, I failed to find the stone, at operation, and no doubt many genito-urinary surgeons have had the same experience. This illustrates at least one of the limitations of the shadowgraph catheter.

In order to reduce this possible error, it has been advised that stereoscopic roentgenograms be made, and Braasch has strongly advocated employing ureterograms. Recently at the Presbyterian Hospital we have resorted to a new procedure which has given us such definite and unquestionable evidence that it seems to me the method should be recorded in order to stimulate others to employ it, as I believe it is a decided advantage over the present methods of technique as described above.

The method was suggested to me by Mr. Earl Ball, radiographer at the Presbyterian Hospital, to whom I wish to acknowledge my thanks for having suggested its use in the two cases about to be reported. This method is not new in radiography, as it has

[1] Kretschmer, H. L. Surg., Gynec. & Obst., 1910, x, 598.

Fig. 1

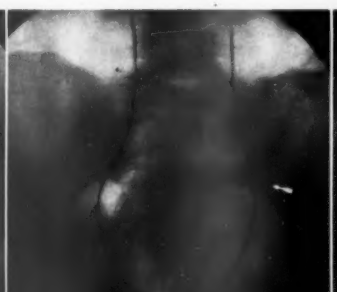

Fig. 2

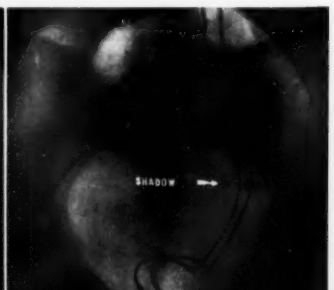

Fig. 3

Fig. 1. Case 1. Shadow in region of right ureter which might indicate a ureteral calculus. Pus and bacillus coli were found in the specimen of urine from the right kidney.

Fig. 2. Case 1. Part of shadow lying in contact with shadowgraph catheter.

Fig. 3. Case 1. Double exposure. Note the interval between the catheter nearest the median line and the shadow. The external catheter and the shadow apparently lie in the same plane.

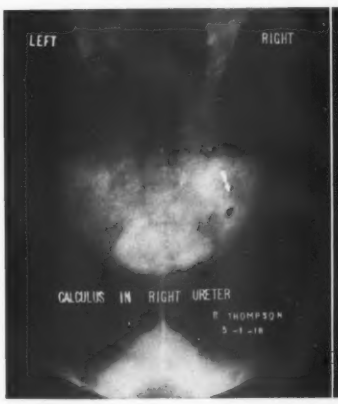

Fig. 4 (at left). Case 2. Calculus in right ureter.
Fig. 5. Case 2. Double exposure. In each instance the stone and the catheter lie side by side.

been employed in the localization of foreign bodies in various parts of the body, but as far as I am aware it has not been employed in the localization of shadows in conjunction with the employment of the shadowgraph catheter.

In a case in which a diagnosis has been made of possible ureteral stone, the shadowgraph catheter is passed in the usual way. An exposure is taken with the catheter in place. A second exposure is made on the same plate without changing the position of the patient or without changing the position of the plate, but by changing the position of the tube, so that one obtains a double exposure on one plate. The results obtained with this technique have been so gratifying that I wish to report the following two cases.

CASE 1. Mrs. E. B., age 32, had pain in the right back, constipation, pain on urination, headache, and loss of weight. The patient states that the present trouble began two years ago following an automobile accident. After the injury the pain was located in the back, right side, and right leg. The pain in the side would come on in paroxysms. She has had three attacks in six weeks. With the attacks of pain she vomited and was constipated. The attacks of "acute indigestion" consisted of severe pain in the pit of the stomach, nausea and vomiting. The duration of the attacks was from three to forty-eight hours.

Following the accident the patient was catheterized, as a result of which she says she developed a cystitis. The attacks of pain in the right lumbar region and right abdomen began six weeks after the accident. Painful urination has been present since the injury. Following the accident she had to be catheterized every day for two weeks.

The general physical examination was negative. The cystoscopic examination showed the presence of a mild cystitis around the internal urethral orifice.

Examination of the urine showed the presence of pus, there being 830 leucocytes per cubic millimeter. Cultures showed the presence of bacillus coli.

Roentgen-ray examination showed a shadow on the right side that was interpreted as being possibly due to a stone in the ureter (Fig. 1).

The possibility of this shadow being a stone in the ureter was considered owing to the fact that the catheterized specimen from the right kidney showed the presence of pus and bacillus coli. It was decided to pass a shadowgraph catheter and further localize this shadow. The shadowgraph catheter was passed. The X-ray showed the shadow and the catheter lying apparently side by side (Fig. 2). A double exposure, however, showed the shadow lying quite a distance from the catheter (Fig. 3).

Because of the fact that in this double exposure a definite interval was seen between the catheter and the suspected shadow, it was decided that this shadow was produced by some extra-ureteral shadow-producing body and that it was probably not due to a stone in the ureter.

Exploratory laparotomy by Carl B. Davis revealed the presence of infection and stones in the gall-bladder, for which she was operated upon, with complete relief of symptoms.

CASE 2. Mr. B. T., age 52, complained of fever, chills, malaise, frequency of urination, and pain on urination.

The patient was in the Presbyterian Hospital in 1916, at which time a diagnosis of hydronephrosis with possible stone was made. Since leaving the hospital the patient has had three attacks of colic. In March, 1918, he had an attack of renal colic accompanied by pain in the lumbar region. He could not use his right leg because of the pain. The present attack began March 25, with severe chills, fever, malaise, and pain in the back.

Cystoscopic examination showed a generalized cystitis. The ureteral orifices were negative. Catheterization of the right ureter showed the presence of much pus. The left ureteral catheterization showed clear urine. Cultures from the right side showed the presence of bacillus coli.

Roentgen-ray examination showed the presence of a shadow in the pelvis compatible with stone in the ureter (Fig. 4). It was decided further to localize this shadow and a shadowgraph catheter was passed and a double exposure on one plate was made with a shift in the tube. This showed the stone and catheter lying side by side. From this fact a diagnosis of stone in the ureter was made. This I was able to verify at operation. I performed an extraperitoneal exposure of the ureter and the stone was removed.

CONCLUSION

1. This simple method has aided us in one instance in making an absolute diagnosis of stone in the ureter that was verified by operation. In the other instance it prevented our operating upon a patient who did not have a stone in the ureter, although the catheter and stone apparently were in the same plane.

2. This procedure can be carried out with one cystoscopic examination and with the introduction of only one shadowgraph catheter.

LOOSE BODIES IN THE ABDOMINAL CAVITY

BY MAX EMMERT, M.D., OMAHA, NEBRASKA

VERY little reference is made in American literature to loose bodies in the abdominal cavity, and with the object in view of summarizing our knowledge in this branch of anomalies, I take the liberty of reporting a recent case in my own experience and reviewing American and foreign literature upon the subject. No detailed reference will be made to foreign bodies, which is understood to mean bodies which have been introduced into the abdominal cavity from adjacent viscera or from outside the body.

The patient, I. S., a single girl, aged twenty, was referred to me on February 12, 1917, complaining of pain in the right lower abdomen. Her mother had died of insanity at the age of 39 years.

The patient had an attack of quinsy three years ago and has had repeated attacks of tonsillitis. Menstruation began at the age of thirteen and had always been regular until the attack of quinsy, since which time she menstruated every two or three weeks. In July, seven months previous, she suffered from an attack of abdominal pain after eating peanuts. The pain was at first diffuse over the abdomen and then localized in the right lower quadrant. She had fever and remained in bed for one day.

The patient dated the present illness from December, 1916, two months earlier, since which time she has suffered daily from pain in the right lower abdomen. Any sudden jar caused the recurrence of this right-sided pain which radiated to the right shoulder, the right thigh, and to the back. At her menstrual periods the pain was continuous and there was a dragging sensation on the right side of the abdomen. She frequently vomited after meals and eructated quantities of gas. She often noticed a sensation of bloating on the right side of the abdomen. For several weeks it was necessary for her to take cathartics.

Examination revealed a well nourished young woman. Head and thorax examination was negative. The abdomen was obese. Deep pressure over the descending colon produced slight pain in the region of the appendix. Slight spasm and tenderness were elicited over McBurney's point and slight tenderness over the right ovary. An indefinite small mass was felt in the region of the appendix. A clinical diagnosis of appendicitis and adhesions was made.

At operation a right rectus incision was made and a large congested appendix was removed. A band of adhesions passing from the cæcum to the right ovary was liberated. A band of adhesions joining

the ascending colon to the transverse colon, producing an angulation at the hepatic flexure, was also liberated. The omentum was congested but not adherent. During the pelvic examination a loose body was removed from the region to the right of the midline and anterior to the true pelvis. The uterus was in good position and normal. The left tube and ovary were normal to the touch. The right tube was slightly congested. The right ovary was normal. The gall-bladder was small and emptied easily. The right kidney was normal in size and consistency.

The patient made an uninterrupted recovery and left the hospital on the tenth day.

The loose body which was removed was almond-shaped, 3 centimeters long, 2 centimeters in breadth, and 1.5 centimeters in thickness. It weighed 50 grains. It was light brown in color and covered with a grayish secretion. There was no evidence of a vestigial pedicle or adhesion. On one side was a calcified plaque occupying about one-third of the surface. The consistency was rather firm.

The body cut with a grating sensation and revealed a distinct capsule about 1 millimeter thick enclosing a finely granular material of a yellowish brown color. Interspersed in this were several small particles of a hard colorless material. No definite nucleus was seen. The contents of the capsule gave a very strong positive guaiac test for blood. Under the microscope it was seen to be composed of fat droplets, crystals, and blood corpuscles. The specimen was submitted to a competent pathologist for detailed examination. His report threw no more light upon the origin of the body, as the capsule was in such a state of disintegration as to prevent a diagnosis of the tissue. He reported unknown cystals in the contents of the capsule.

From the gross examination of the body we are justified in drawing the following conclusions:

1. It had been a viable body covered by a definite capsule and containing fat.

2. During its period of viability there had been an impairment in the circulation, as evidenced by the calcification in the wall.

3. At some time there had been an injury or strangulation which had produced a dissemination of blood throughout the interior of the body.

4. The body had been separated from its blood supply for some time because of the disintegration of the capsule.

I have been able to find in literature the description of seven bodies which were similar in many respects to the one just described. The body reported by Ogle (4) was lodged in a depression on the upper surface of the right lobe of the liver, and fell out during the examination of the abdominal viscera. It had evidently been held in position by the pressure of the diaphragm. There was no evidence that it took its origin from the liver. A similar body, described by Van der Byl (5), was found lying below the posterior thick border of the liver. At one point the surface of the body was abraded as if a slight adhesion had existed. The body described by Wilks (7) showed an attachment to one side of a "filament of cellular tissue about one inch long, whose other end was free."

The specimen reported by Murchinson (10) also showed the presence of filamentous shreds on one spot. Hektoen (14) found two bodies in depressions on the summit of the diaphragmatic surface of the right lobe of the liver, one of which was connected to the margin of the depression by a thin fibrous band. Both bodies were found in cadavers of males over forty years of age. Another body of similar character, but not free, was found by Arthur Meyer (17) within a small sac twice its size on the intestinal surface of the ventral wall of the great omentum. Van der Byl (8) reported the finding, in the abdominal cavity of a female, of another body similar to the one previously described by him.

These seven free bodies and the encysted body are similar in the following respects: (1) The capsule consists of a fibrous-like tissue varying in consistency from fibroid to semi-cartilaginous. (2) The contents of the capsule consist largely of fat in varying degrees of liquefaction. Three of these bodies showed remnants of a pre-existing pedicle or attachment. One of these was found in a depression on the surface of the liver, one in the hernia sac, and one on the left side of the abdominal cavity. Three bodies were found in depressions on the surface of the liver, showing the tendency for the small body to be held between the diaphragm and the liver, and the ability of the liver to adjust itself to the presence of the body without evident injury to the liver. The only change was a thickening of the capsule of the liver which formed the floor of the depression.

These seven bodies are so similar in structure that it is justifiable to suppose that they

had a similar origin. Undoubtedly following their detachment from the parent tissue they all had vestiges of a pre-existing pedicle or attachment. In four of the bodies these vestiges had been completely removed, probably by the mechanical action of the body rolling around among the loops of intestines.

There is another class or group of bodies found in the abdominal cavity, a typical example of which was removed from a hernia sac at operation by Shaw (3), whose classical description I shall quote verbatim.

> The body in long diameter measured one and one-half inches, in short diameter one and one-fourth inches. In whiteness and smooth shining surface it had some resemblance to a hard boiled egg with the shell removed, but in a few places the surface was broken and pitted. No trace of the remains of a pedicle could be perceived. On section, resistance to the knife was like cutting through a dense fibrocartilage. Near the center a grating was felt as if the knife were passing through thin bone. The body consisted of three parts. The external white cartilage-like part constituted the greater portion of the body, and closely surrounded an oval cyst in the center. The cyst measured one-half inch by one-fourth inch. The walls were two lines in thickness and were formed of compact thin layers of calcareous matter of a light yellow color, like the deposit on arteries of old people. The cyst was filled with common fat. The cartilaginous part consisted of layers of varying degrees of thickness which could be pealed off as an onion. Under the microscope this was a homogeneous granular membrane totally devoid of anything like cells, nuclei, or true fibers.

To this group of free bodies belong those reported by Canton (2), John Reid (6), Rolleston (11), Hoche (15), Berge and Gutman (16), and Campbell and Owen (18). The similar characteristics which place these bodies in the same grouping are; first, the shell which consists of a thick lamellated fibrous-like structure; and second, the nucleus which varies in consistency from that of fat to a calcified stone. Several of these nuclei of the softer consistency have a definite capsule interposed between the soft material and the fibrous-like shell. It is this fact which connects these two classes of loose bodies and points to a common origin.

The origin of these bodies is a matter of interest and much early speculation. Velpeau, who found a similar body in a young girl who had died from pulmonary tuberculosis, considered it to be a fibrous concretion resulting from a blood-clot. This early view was accepted by Hunter, and Lavey, Laennec and Bechard. Andral and Lebert believed the formation took place under or outside the serosa, a pedicle formed and the pedicle ruptured. Therefore it was their theory that all of these bodies had a peritoneal coat. Cruveilhier considered them productions born on the surface of the spleen, which had become detached. Bouillard thought that they were analogous to vesical stones.

It remained for John Reid in 1836 definitely to consider the appendices epiploicæ as the probable origin of these bodies. Since that time this view has been generally accepted by the English and French schools, and evidence has accumulated to substantiate this early view. Wilks (7) reported the discovery of a body the size of a large pea in an appendix epiploicæ which seemed to grow from the side of that structure. This body was similar in morphology to the one described by Shaw. He called attention to two specimens in Guy's Hospital Museum, one showing a bifurcated appendix twisted on its pedicle so as to appear strangulated, the body appearing not much changed, and another showing a further stage in that its attachment to the intestine consisted of a mere filament. Van der Byl (8) also reported altered appendices attached to the sigmoid and transverse colons, one of which was very firm and presented a semi-cartilaginous consistency, while the other was dark colored and apparently contained blood.

Another source of origin of these bodies is the great omentum. Henry Thompson, reporting a case for Nesbitt (9), stated that prior to operation for a strangulated hernia, they could feel a hard mass in the hernia sac and upon opening the sac they found a rounded body the size of a nut attached by a very small pedicle to the omentum which also formed a part of the hernia. On section, this pedicle was found to be continuous with the adipose tissue which constituted the principal bulk of the body. At the edge of this fat was a hard calcareous crust, investing which was a dense capsule cutting as does cartilage. This capsule under the microscope was of a lamellated homogeneous character.

Another report substantiating the omental origin is the case of Hoche (15), in which he found not only a free body but several fatty lobules which were attached to the great omentum by fibrovascular pedicles. These lobules were one and one-half centimeters in diameter.

The formation of these loose bodies is comparatively clear up to a certain point. We can easily imagine that these pedunculated appendices epiploicæ or lobules of fat might become twisted upon their pedicles. A partial torsion would interfere with the blood supply and promote calcareous infiltration. The increasing weight of the body and necrosis of the pedicle would eventually result in a detachment from the parent tissue and a loose body would be present in the abdominal cavity. The similarity between this hypothetical body and the class of bodies first described is obvious. I do not think it is presumptuous to claim that the nucleus of the second class of bodies is similar to the hypothetical body.

The formation of the lamellated fibrous shell of the second class of bodies offers abundant opportunity for speculation. Shaw (3) thought that the surface of the free body became coated with minute particles of fibrin derived from the serum of the peritoneal cavity; that this process, if continued long enough, would result in the formation of delicate fibrinous lamellæ arranged in concentric order, and thus all appearance exhibited in the specimen would in time be presented. John Reid (6) considered it as a mechanical deposition of coagulated albumin and stated that the concentric layers of aneurismal coagula and the so-called deposits on the valves of the heart were of the same character. He called attention to the coagulating action of albumin on fat, as first shown by Acherson, to support his contention. Arthur Meyer (17) denies the possibility of growth of loose bodies after detachment.

The detailed examination of the body found by Hoche (15) and his masterly presentation of this subject offers the most scientific and logical explanation for the growth of these bodies after detachment. Upon examination of the dissociated lamellæ he found that they clearly gave the reaction for fibrous tissue. In the interstices of these fibers he found fusiform cells similar to those in the tissue of the conjunctiva. Toward the periphery, these cells were more apparent, the nucleus less thin and flat and the protoplasm more visible. Some cells near the surface were distinguished, being surrounded by fine granulations or light homogeneous fibrillar substance, which might be fibrous transformation. He believes that the capsule is formed by the free collagenes cells of the peritoneal cavity which successively deposit themselves upon the surface of the free body and secrete the fibers or fibrils; that they derive their nutrition by imbibition from the serous environment. As these cells are separated from the periphery by successive deposition of other cells, "they lose little by little their means of nourishment and undergo a granulo-fatty degeneration of protoplasm and granulation of the nucleus."

One interesting fact remains to be noted, namely, it is not necessary for the body to be free in the abdominal cavity in order to acquire this fibrous capsule. This dictum is supported by the case of Nesbitt (9), which had the characteristics of the body described by Shaw but was attached to the omentum by a definite pedicle.

As a clinical entity, little can be said concerning these loose bodies. The majority of them have been found at autopsy or when operating for other causes. It is very questionable whether or not they produce symptoms after detachment. In the case reported by Campbell and Owen the patient had felt a mass in his abdomen for twenty-five years. For forty years he had suffered from digestive disturbances, as burning sensation in the stomach after eating, distention and discomfort from gas and from constipation. However, these symptoms could not be attributed to the loose body alone because of the other pathological conditions revealed at autopsy. The majority of these bodies have been removed from men over sixty years of age. The youngest patient, prior to my case, was thirty years old. The condition is more prevalent in men than in women.

These two groups of bodies constitute the majority of loose bodies found in the abdom-

inal cavity. However, bodies of entirely different origin have been found, as illustrated by the following case reports.

Simonin (1) reported the finding of two small loose bodies in the abdominal cavity of a cadaver which were the size and shape of two small horns or cucumbers. They were formed of a cartilaginous and bony tissue contained in a membrane absolutely free in the pelvis and floating to the right of the bladder and rectum. They were greenish brown in color and weighed 38 grains. In dimensions they were two inches long and six lines broad at the center. He considered them to be vegetations of the peritoneum.

Kaschewarrowa (14) described an interesting body found at operation in the abdominal cavity of a woman. It was the size of a small egg and was invested by a complete membrane. Under the first layers of the body was a thick serum. In the center was a small cavity containing a worm-like mass with no regular structure, but under the microscope embryonic tissue of the heart, lungs, brain, liver, and muscle were recognized. She considered this body to be the product of an extra-uterine pregnancy.

Reindfleisch (13) found in the right iliac fossa of a female cadaver a free hard body the size and shape of a goose egg, with a smooth surface of yellowish color. Microscopic examination proved it to be a typical fibromyoma. Reid reported a free fibroid in the abdominal cavity with a similar tumor attached to the uterus.

Sperling and H. Stein found at operation at the Koenigsberg clinic a free body the size of a child's head which proved to be a fibromyoma with retrogressive transformation. There was evidence of a pre-existing chronic peritonitis and adhesions.

Rokitansky reported a case in which a tube and ovary were free in the abdominal cavity. A similar case was reported recently in this country by DuBose (19). Turner reported a case with an ovary and uterine fibroma free. Lobstein found a dermoid cyst free in the abdominal cavity.

Several classifications of loose bodies, based upon possible origins, have been suggested but as they are not substantiated by fact or case reports, I shall not include them in this review.

In conclusion I would call attention to the fact that while any pedunculated mass in the abdominal cavity may become detached and form a loose body, it is a comparatively rare condition and that the majority of these loose bodies have had their primary origin from the colon or great omentum.

I append hereto a résumé of observations collected by Vercoutre which consisted of 28 observations, of probable epiploic origin, reported between the years 1703 and 1872. To these Hoche added 5 cases which he had found in literature. To this résumé I wish to add the cases reported by Ogle (4), Murchinson (10), Hektoen (14), Berge and Gutman (16) and Campbell and Owen (18).

RÉSUMÉ OF FORMER OBSERVATIONS OF LOOSE BODIES IN THE ABDOMINAL CAVITY WHICH PROBABLY HAD THEIR ORIGIN IN THE COLON OR GREAT OMENTUM

1. Reported by Littre in 1703, a smooth white body of cartilaginous consistency 1 inch 2 lines by 10 lines by 7 lines in size. This was found in the peritoneal cavity. The nucleus was a round white stone and the capsule was of the same nature as the nucleus.

2. Reported by Lebidois in 1824. Two white bodies were found in a man seventy years of age. These bodies were the size of a walnut, of hard consistency and weighing 5½ drachms. The nucleus was a stone-like structure the size of a filbert. The capsule was of a white color and arranged in concentric layers.

3. Reported by Andral in 1829. Many bodies of cartilaginous consistency, some of which had pedicles.

4. Reported by Bechard in 1829. A body the size of a walnut with a nucleus the size of a pea. Fibrocartilaginous in consistency.

5. Reported by John Reid in 1836. Many bodies were found in the pelvic peritoneum of a male eighty years of age. One was as large as a billiard ball and round and glistening in appearance. It had the consistency of an albumin concretion. The capsule was fibrocartilaginous. The nucleus was calcareous in part and many fat cells were present. Reid considered them detached appendices epiploicæ.

6. Reported by Deville for Cruveilhier in 1851. A single body the size of a billiard ball was found in the peritoneum.

7. Reported by Laveran in 1845. Twelve small pellets, uniformly white, were found among the intestines of a male. Many adhesions were present. These bodies were of a fibrocartilaginous consistency and elastic. The nucleus was firm and the capsule stratified.

8. Reported by Letixerant in 1849. A hard body found in the peritoneal cavity with a very hard nucleus.

9. Reported by Canton in 1850. An oval glistening brownish yellow body was found in a hernia sac of an old man. The body weighed 1½ ounces and was 2 by 1½ inches in diameter. The capsule consisted of fine superimposed lamellæ which comprised one-fourth of the

entire thickness of the body. The nucleus was a fatty mass the size of a marble.

10. Reported by Canton in 1851. An oval white body of resistant consistency was found in the peritoneum. The body was 4 by 3 cm. in size. The capsule consisted of concentric layers of fibrous tissue. The nucleus was a hard cretaceous mass the size of a hazelnut.

11. Reported by Deville in 1851. From the body of a male aged thirty years were removed 5 almond shaped bodies the size of a chestnut. The capsule was an imbricated opaque fibroid structure and the nucleus was fatty. There were evidences of a pre-existing chronic peritonitis. The bodies were found in the peritoneal fossæ.

12. Reported by Barth in 1851. Many bodies, some the size of a hazelnut, were found in the peritoneum of a woman. Some were free, others hanging from the peritoneum. The surface was cartilaginous; underneath this the tissue was fibrous. The nucleus was calcareous.

13. Reported by Lebert in 1852. A body near the hepatic peritoneum. The capsule consisted of concentric fibers and the nucleus was calcareous. There was evidence of a vestigial pedicle.

14. Reported by Leconte in 1853. A body the size of a small billiard ball weighing 55 grains and 14 cm. in diameter was found in the retrovesical cul-de-sac of a man sixty-seven years old. The body was spherical and glistening, being as smooth as a serous surface. The capsule was dull gray in color and consisted of concentric layers. The nucleus was small and calcareous and was composed of carbonate and phosphate of lime.

15. Reported by Deville in 1854. A body the size of an almond with an imbricated covering and a fatty nucleus.

16. Reported by Shaw in 1854. An oval body of solid consistency was found in a hernia sac of a man aged 62. It was as large as a pigeon's egg, being 1½ by 1¼ inches in diameter. The capsule was fibrocartilaginous and the nucleus of a cretaceous fatty material. He considered it a product from an appendix epiploicæ.

17. Reported by Ogle in 1855. A body the size of an almond found on the surface of the liver. It was of a pearly white color and had the consistency of cartilage. The capsule was $\frac{1}{12}$ of an inch thick and the nucleus was composed of a friable yellow material. Shreds of fibrous tissue were present on the surface.

18. Reported by Gouboux and Robin in 1856. A body of hard consistency with the appearance of a lipoma in a horse. The external capsule was of cellular tissue; the nucleus was fatty. A pedicle 20 to 40 cm. was present.

19. Reported by Van der Byl in 1857. A body about ½ inch long was found in the pelvis of a woman. The surface was smooth and shiny. The nucleus was of a pulpy yellow material with gritty particles. Trace of a pedicle. Origin thought to be appendix epiploicæ.

20. Reported by Van der Byl in 1857. Two bodies, ¾ of an inch long, in a man; attached to the transverse colon; were of hard cartilaginous consistency, one having a brown color; pedicles were very fragile. Origin thought to be appendices epiploicæ.

21. Reported by Brown and Wilke in 1857. In the peritoneal cavity on the left side found a body the size of a bean. The capsule was fibrous and $\frac{1}{20}$ of an inch in thickness. The nucleus was composed of a soft yellow fatty and vascular material. A filament of cellular tissue on the surface. Origin thought to be the appendix epiploicæ.

22. Reported by Poisson in 1857. A body the size of an almond with a smooth surface was found in the peritoneal cavity of a man.

23. Reported by Brown and Wilke in 1857. An oval hard body the size of a large pea was found in an appendix epiploicæ attached to the intestine. The capsule was composed of numerous fibrous layers. The nucleus was yellow with a calcareous shell. Peritoneal pedicle.

24. Reported by Michel in 1859. Two bodies, one the size of a hazelnut and the other as large as a marble, were found in depressions on the psoas muscle. They were of bony hardness with a smooth surface. One had a very long pedicle.

25. Reported by Virchow in 1862. An ovoid body the size of an almond found in the abdominal cavity. It had a cartilaginous consistency. The capsule was composed of concentric lamellæ and the nucleus was stony in appearance.

26. Reported by Virchow in 1862. Found in the abdominal cavity a loose body with a dense capsule and fatty nucleus.

27. Reported by Murchinson in 1864. A smooth white body the size of an egg was found in the hernia sac of a male aged sixty years. It had a fimbrillated capsule and a nucleus of fat.

28. Reported by Blandin in 1869. A body which he stated was analogous to that reported by Shaw. (See No. 16.)

29. Reported by Greenhow in 1872. Three bodies near the cardiac end of the stomach in the body of a female. One was larger than a hen's egg, the other two being much smaller, ovoid in shape with a smooth glistening surface of dirty color. The capsules consisted of concentric lamellæ formed by parallel fibers. The nucleus was small and calcareous.

30. Reported by Wood in 1872. A body found in a hernia sac which he reduced into the abdominal cavity.

31. Reported by Demanlin in 1889. A body as large as an almond found in the Douglas' pouch. It was smooth and soft and of a bluish-white color. The capsule was very thin and was formed of connective tissue. The nucleus was composed of fatty material and epithelial débris.

32. Reported by Sottas in 1891. A body as large as a hen's egg was found in the cul-de-sac of a man aged sixty years. It was of elastic fibrous consistency with a smooth glistening surface of bluish color. The capsule was formed of regular concentric layers of very hard fibrous tissue. The nucleus was the size of a pea and very hard.

33. Reported by Hektoen in 1890. Two bodies of grayish color were found on the surface of the liver in a man aged forty years. They were 1½ cm. by 3 mm. in diameter and quite firm in consistency. The capsules were semi-cartilaginous and the nucleus of a yellowish granular material. Fibrous bands were attached to them. Origin thought to be appendices epiploicæ.

34. Reported by Monnier in 1891. A body the size of a kidney bean, 3 by 2 cm. by 15 mm. in dimensions and of a hard uniform consistency. The capsule consisted of concentric lamellæ and the nucleus was of a yellowish material with a whitish gray elastic capsule or shell.

35. Reported by Letienne. A body the size of a nut was found among the intestinal loops in a man aged sixty years.

36. Reported by Hoche in 1910. A body the size of a hen's egg weighing 55 gm. was found in the pelvis of a man aged seventy-seven years. It had the appearance of a hard boiled egg with the shell removed, being bluish white in color. It was firm in consistency and a little elastic. The capsule was composed of concentric lamellæ. The nucleus was small and yellowish in color and composed of cholesterin crystals and fat. There was a trace of a pre-existing pedicle. Origin thought to be the appendix epiploicæ.

37. Reported by Berge and Gutman in 1911. A body the size of a kidney bean in the abdominal cavity of a man aged sixty-five years. It was smooth and glistening and of a firm consistency. The capsule was lamellated and the nucleus a calcified stone. Origin thought to be appendix epiploicæ.

38. Reported by Campbell and Owen in 1914. A body the size of a hen's egg removed from the abdominal cavity of a man aged sixty-nine years. It was white and glistening and very firm. The capsule was lamellated and the nucleus calcareous. They considered it a detached fibroid or fibroma.

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A STUDY OF THE DEVELOPMENT OF THE EPIPHYSIS[1]

By PHILIP H. KREUSCHER, M.D., Chicago

HOW frequently we make errors in the diagnosis of fractures about the joints in the young. We forget that there are various centers of ossification and various stages of development in the epiphyses of the long bones of children and adolescents. The X-ray misleads us so frequently in the fractures and dislocations around the elbow, knee and hip joints that I deemed it advisable to make a very thorough study of the normal conditions which exist in children and young adults. We have occasionally found ourselves attempting to nail or suture an epiphysis to the shaft of the bone, which normally does not completely ossify until the eighteenth or twentieth year. On the other hand, we ignore important anatomic structures because the ossification is shown in the X-ray plate as a very small and insignificant looking body. I will present illustrations which seemingly show fractures through the olecranon and os calcis, but which are in reality not fractures at all.

It is most important that we should be able to distinguish between the normal and abnormal rœntgenograms of a child's joint. In the very early periods of bone development the epiphysis is entirely cartilaginous. With the appearance of the center of ossification, there is a gradual disappearance of the cartilage until only a shell remains, surrounding the cancellous epiphyseal bone and marrow. The cartilage at one end persists to form the articular cartilage, while at the inner boundary it forms a part of the epiphyseal cartilage line. This part of the epiphyseal line toward the epiphysis is designated as the epiphyseal ossifying cartilaginous layer. It consists of hyaline cartilage with irregularly scattered nuclei and from its epiphyseal side, ossifying buds of cartilage extend into the epiphysis. In the older animals the part of the shell of cartilage connecting the articular with the epiphyseal cartilage line undergoes complete ossification, so that the articular cartilage is no longer found to be inserted into the epiphyseal line. The remainder of the epiphyseal cartilage line is composed of columns of cartilage cells, the nuclei of which are flat and heavily stained near the epiphyseal ossifying cartilage layer, but gradually become round and larger on nearing the metaphysis, until they are finally of a vesicular structure with a surrounding light staining protoplasm. These large vesicular cells form the boundary between the epiphysis and the metaphysis, and finally become a part of the latter. It is by the proliferation of the cartilage cells of

[1] Read before the Chicago Surgical Society, April 5, 1918. (For discussion see p. 542.)

the epiphyseal cartilage line that the longitudinal growth of bone is maintained.

Because of this complex form of development, it has been found impossible to transplant the epiphyseal line. Haas and von Tappeiner have made some very interesting experiments of reimplantation and homoplastic transplantation of the epiphyseal line. They both concluded that the epiphyseal cartilage line ceases to functionate, either when transplanted by itself or with a small or large piece of adjoining bone, or even when transplanted as an entire intact bone. The first change after transplantation consists of a fragmentation of the cartilage columns near the epiphyseal ossifying layer. Then there is a fibrous substitution of the remaining parts and finally complete ossification occurs. The only evidence of regeneration is near the periphery between the perichondrium, which part seems to retain its property of producing cartilage. This *new* cartilage possesses none of the length-producing functions of the normal epiphyseal line. Haas believes that the loss of growth from the epiphysis is due to interference with the vascular supply from the diaphysis to the epiphyseal cartilage line.

In order to get a better understanding of the development and growth of bone, let us consider the roentgenograms of a newborn, fully developed infant (Fig. 1). A center of ossification in the distal epiphysis of the femur is so constant in the newborn that Lambert calls it a "sign of maturity." Swengel found it to appear between birth and the third year. Hartmann found it lacking in 12 per cent of cases at birth.

The four parts of the occipital bone are separated from each other by thin layers of cartilage, the mastoid portion of the temporal bone is not ossified in its entire extent; the lateral halves of the frontal bone are still separated. The vertebræ are ossified in all their essential parts, but the centers of ossification are separated from each other by cartilage (Fig. 2). In some cases the proximal epiphysis of the humerus is ossified, but the ossification of the greater and lesser tuberosity comes later. At the lower end of the humerus the ossification centers are not present, at birth the one for the external condyle coming between the thirteenth and fourteenth year, and the center for the external epicondyle between the eighth and tenth year. The internal condyle develops from the fifth to the sixth year, and the internal epicondyle at the eighth or tenth year. I mention these especially because they are so frequently involved in fractures about the elbow joint in children. In the hand all bones are ossified at birth, except the carpus, in which the centers of ossification in the os magnum and unciform may be seen very rarely. The cuneiform is seen at third, trapezium and semilunar at the fifth year, scaphoid at sixth, trapezoid in eighth, pisiform at twelfth year. The ossified portion of the os pubis usually surrounds only a portion of the anterior boundary of the obturator foramen, while the region of the symphysis and upper margin of the horizontal ramus of the os pubis remain cartilaginous.

No ossification centers are present at birth in the upper end of the femur, the one for the head coming during the first year, for the greater trochanter about the third year, and for the lesser trochanter from the thirteenth to the fourteenth year. The centers for the proximal epiphysis of the tibia and fibula and those for the metatarsal bones, such as the cuboid and the three cuneiform bones, are usually not present at birth. The os calcis develops by a single center, which appears about the sixth month of fœtal life, but the ossific center for the epiphysis of the os calcis appears only at the ninth year. The astragalus appears at seventh month, the cuboid at ninth month, external cuneiform first year, internal cuneiform third year, mid cuneiform and scaphoid at fourth year.

In describing the variations in the epiphyseal development, Hess states that the growth and development is influenced largely by pathologic conditions of the mother and the fœtus, such as syphilis, rickets, osteogenesis imperfecta, etc. These same lesions will, of course, retard or change the development after birth as well as before.

The roentgenogram presented shows the development at birth. The technique for the production of this representation was worked out by Julius Hess, of Chicago.

Thus having a good working knowledge of the appearance of the normal human skeleton at birth, let us turn our attention to the subsequent developments of joints, which most interest the surgeons. I have mentioned the time of development for the ossific centers at the lower end of the humerus, the proximal end of the femur, and the changes as they occur at the ankle-joint.

The lesions which most interest us are, first, fractures and dislocations; second, inflammatory lesions; third, changes due to direct trauma; and fourth, abnormal developments caused by nutritional disturbances, principally rickets.

The first case which attracted my attention was one of congenital hip dislocation in which I had attempted to make a bloodless reduction. The roentgenogram which was made after this futile attempt led me to believe that a portion of the head of the femur had been torn away and displaced alongside of the neck. An open operation was performed and we found that the head of the femur had not been injured, in fact, was quite normal, except for the marked flattening on the one side where it had rested against the ilium above the acetabulum. We did find, however, that the entire greater trochanter with its center of ossification had separated and lay alongside of the neck.

Metcalf reported a separation of the epiphysis of the small trochanter of the femur following a direct injury. Aside from the positive diagnostic evidence of the X-ray, he mentions clinical symptoms, such as localized pain and tenderness, inability to flex the thigh, or Ludloff's sign, which is a localized swelling or ecchymosis in the upper part of Scarpa's triangle.

In the adolescent coxa vara, which was thought to have been due entirely to rachitic changes, Steindler, in a very able article, seems to prove that all of these cases are primarily separation of the epiphyses, at least as far as the coxa vara capitalis is concerned.

I will show you the roentgenogram of a case of traumatic separation of the lower end of the epiphysis in a boy aged 14. In this case the trauma was a direct one and so violent that a fracture extended up into the femur (Fig. 9). MacAusland, Demarest, Binney, and others have reported such separations. Tanton reported a very rare injury, that of a traumatic separation of the superior epiphysis of the tibia. One case of separation of the lower epiphysis of the humerus with rupture of the brachial artery was published in the report of St. Bartholomew's Hospital, London. Neuhoff speaks of a traumatic intra-acetabular separation of the pelvic bones and calls it an "epiphyseal diastases in the acetabulum." Kellogg Speed reported a very interesting case of an epiphyseal fracture of the lower end of the radius, which he differentiates definitely from a true Colles' fracture.

After diagnosis of epiphyseal separation has been made, it is quite necessary that complete reduction be made at once. *In these cases* as in ordinary cases of fracture, exudation of blood occurs between fragments not widely separated, which exudation if followed by an infiltration of round cells and later organization might result in the obliteration of the growing function of the epiphysis, and finally give a short bone. I remember having seen one such case in which the internal malleolus was involved. A fracture at the junction of the malleolus with the shaft occurred in a patient at the age of 14. The internal malleolus remained very much shorter and a marked incapacitating inversion deformity of the foot resulted.

There has been some speculation with reference to the retardation and stimulation of the growth of bone. Sayre reported a case in which he believed that a slight trauma to the upper epiphysis of the femur aided probably by the hyperæmia of the leg produced by the rather snug bandage had markedly stimulated the growth of the extremity. Meisenbach states that the growth of the epiphysis can be influenced by chemical means and that a chemical stimulation of bone can be brought about by the injection of formalin and glycerin.

A very frequent site of inflammatory changes at the epiphysis is at the upper end of the tibia, where the epiphysis is seen to have a tongue-like projection extending down the front of the bone to the tubercle of the

Fig. 1. Showing a fully developed infant at birth. Note the absence of carpal bones.

tibia (Fig. 8). Here we frequently see the typical Schlatter's disease, which is also known as epiphysitis tibia (Fig. 8). In these cases we have that peculiar worm-eaten appearance at the epiphyseal line, which begins near the tip of the tubercle and extends upward and backward. Clinically, the pain, tenderness, and swelling over the tibial tubercle may or may not be due to a trauma. A thorough knowledge of the normal picture is necessary to distinguish between the starting of the epiphysis, as described by Scudder in his latest work on fractures, and fractures or avulsions at that point. From an examination of a large number of plates it was found that there was a separate ossification center in

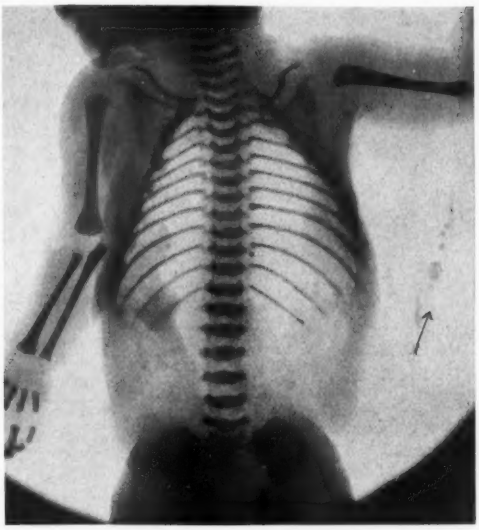


Fig. 2. The skeleton at birth showing the detached sternum with its various centers of ossification. Note the distinct separation of the vertebral bodies.

no child under ten, which would mean then that Schlatter's disease does not develop

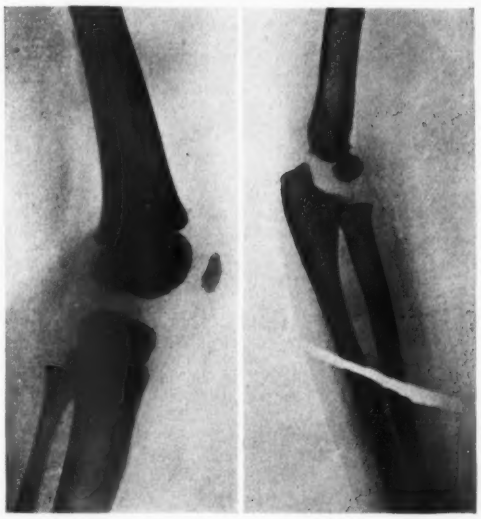


Fig 3. Showing development at knee and elbow joints, (at age 4). Note the center for the patella, also for the upper end for the radius and fibula. The epiphyseal line for the femur and tibia are plainly marked.

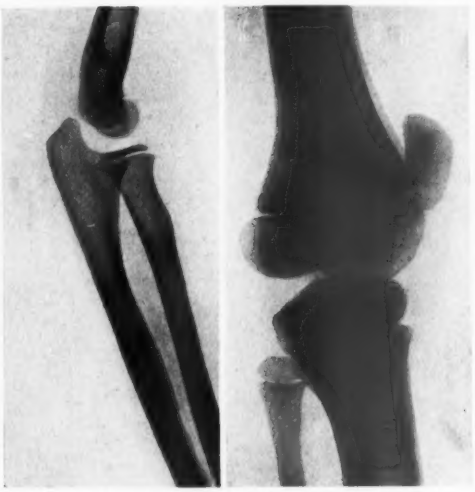


Fig. 4. Showing the development at age of 8. Note the large and completely formed patella.

until after the tenth or eleventh year. A similar condition with the same symptoms of inflammation is found in the hip, known as Perthes' disease. Naturally, the condition in the hip is more serious on account of the larger epiphysis and greater function of that part.

Fig. 5. Roentgenogram at age of 10, showing the well developed head of the fibula. Note the absence of the center for the olecranon.

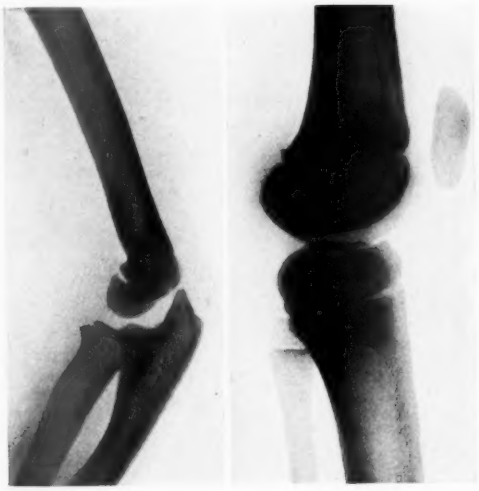


Fig. 6. Roentgenogram taken at age of 12, showing for the first time the center of olecranon. Note an apparent separation of the condyle of the humerus.

The deformities which follow injuries to the epiphyseal line are not rare. We have those due secondarily to osteomyelitis or tuberculosis, but probably more frequently to a direct interference with a portion of the epiphyseal

Fig. 7. At age of fifteen, the epiphysis of the upper end of the tibia and a tongue-like projection extending down the front of the bone. Note the separation of the tip of the olecranon (not a fracture).

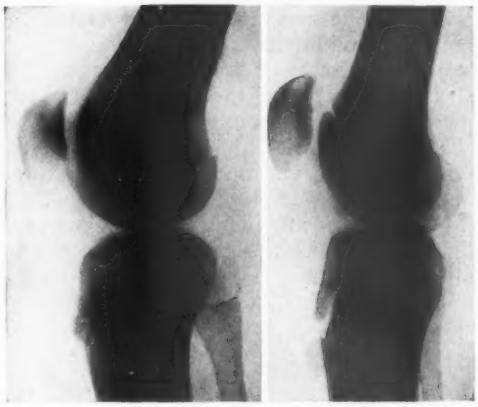


Fig. 8. At age of 15, showing normal knee to the right, and at the same age a Schlatter's disease to the left.

line. I shall never forget the case of extreme deformity at the knee-joint which I saw when I was an interne. This deformity was due to the fact that the epiphyseal line on the inner aspect of the femur was destroyed during an

Fig. 9. Showing an epiphyseal separation and fracture extending into the femur.

Fig. 10. Showing rachitic deformity at the age of 15. The epiphyseal line on one side continues to grow while on the other side the growth is retarded.

operation for osteomyelitis in the lower portion of the shaft. What resulted? The inner head or condyle of the femur ceased growing, while the outer half continued its growth with a resultant incapacitating bowing at the knee.

Sever reports a case of apparent idiopathic obliteration of the epiphyseal line accompanied by a marked overgrowth of the external condyle in the lower end of the femur in a child of 8.

We have all seen the deformities which take place at the epiphyseal line in the nutritional disturbances, especially those of rickets. In these it would seem that a portion of the epiphyseal line retards its activities,

while the remainder continues or increases in its bone production (Fig 10). In these cases, however, the epiphyseal line is not destroyed, as under proper treatment and forcible correction most of them recover entirely without deformity.

CONCLUSIONS

In conclusion permit me to emphasize:

1. That a thorough knowledge of the normal structures and their time of appearance is necessary intelligently to treat the abnormal conditions.

2. That fractures at the epiphyseal line should be recognized early and reduced completely to avoid deformities.

3. That injuries about the joints in the young must never be treated lightly and haphazardly.

4. That operative injury of the epiphyseal line is inexcusable with our present knowledge of its importance.

ANALYSIS OF THE WORK OF THE UTEROLOGIST[1,2]

By ROBERT L. DICKINSON, M.D., F.A.C.S., Brooklyn

THIS Society might with propriety make a survey of the joint specialties of which it is the national representative. Basic betterments are needed which only wide and extensive study can bring about. Before we can formulate standards we must get the data together. Other crafts have shown us how to select the best in technical dexterity, and other organizations have indicated how our institutional service should be taken apart to be reassembled and refunctionated. We have not profited. We hardly have such things as standards, instruction, inspection.

If this seems an extreme indictment let any statistician ask whether we have agreed on the names of diseases or of operations; or a modern machine-shop operator inquire concerning the determination as to the best material to be used for, or the form of, the commonest instruments; or the trained bricklayer, about our study of the swiftest motions as in tying a knot; or the chemist or printer, as to our symbols and abbreviations; or any corporation head, as to how we chart our personnel. Whether it be nomenclature, procedure, tool, transference of skill, professional organization — of all alike it is true that no general analysis has been made and none of those agreements reached which are common to other industries.

We have no real instruction in hospital procedure — such as shops are used to — no written practice in general, nor cards for each process. Who instructs the new visiting surgeon in all his duties? Who drills the new surgical assistant in technique? What full and authoritative book of methods is accessible to the new interne, the new head nurse in the operating room, or to any other recently acquired member of the staff?

We have no real inspection. What chief goes regularly into his dispensary? Who checks up the visiting surgeon or physician? What local or state or national medical society, or municipal or state representative visits your hospital and mine to report upon our technique, our equipment, our staff, our results?

We have no wide view of our work plotted, charted, defined by its character and worked out in detail by function, and regrouped according to the best practice of the new scientific methods. These four principles — standards, instruction, inspection, and functional management — have reached most of the other fields covering as large a ground as ours. Why not the health industry?

Graphic representation. To the statistician figures may make mental pictures, but most

[1] Read before American Gynecological Society, Pittsburgh, June 2, 1917.

[2] In the absence of a term to designate the combination of gynecology and obstetrics, or the man who practices both, I use any word at the head of this paper to emphasize the need. This hybrid will make the ghost of A. Rose flush with indignation. Yet when I tried I could not get that perfervid Greek to reduce our nine-syllable-hyphenated-cognomen to something as short as "Frauenarzt."

CHART 1.—LACK OF ORGANIZATION — USUAL TYPE OF GENERAL HOSPITAL

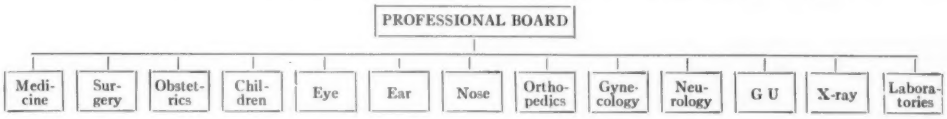
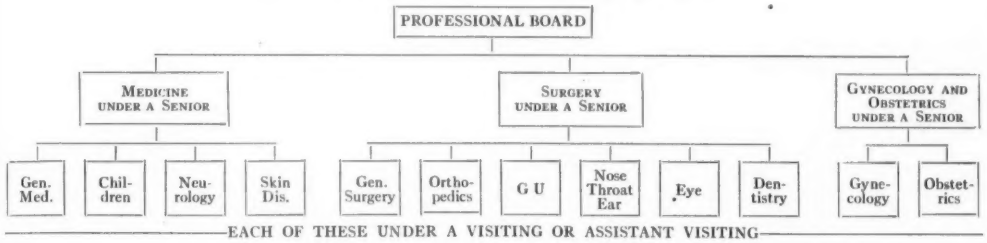


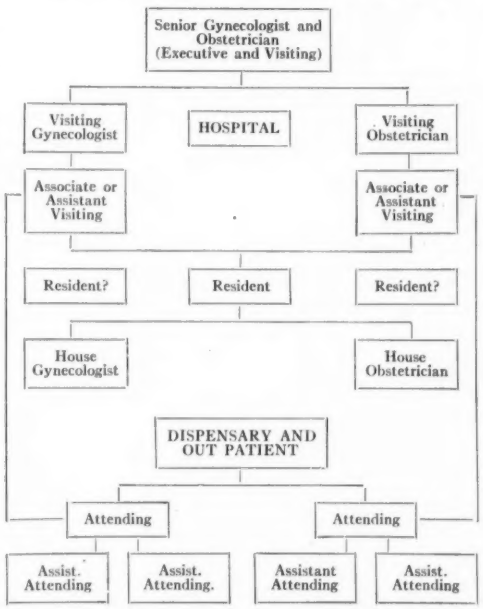
CHART 2.— ORGANIZATION BY LARGE GROUPS



of us need something simpler. A temperature, charted, means more at a glance than considerable study of the digits written down in columns can convey. We make little use of those graphic representations that fix facts and show the peak and valley of our activities. Without experimenting, I do not see how we can determine which of the graphic methods of depicting what our department is doing can be of real service and repay the labor required. Therefore I submit to you some of the things that seem most worth while and some that are merely of passing or local interest.

Charts of personnel and organization. Take the simplest consideration of organization. In a given general hospital what relation exists between gynecology and the rest of the specialties? Is it, as in many general hospitals, one of the thirteen or fifteen services of equal rank, very loosely related and reporting only to the medical board? Is it a group of volunteer workers which has no real responsibility to any body, and is subject to no inspection? Chart 1 shows the customary lack of organization in the usual hospital of 300 beds. Chart 2 shows the hospital in which three main departments group within themselves all the specialties. The surgical specialties are classed as surgery, the medical specialties as medicine, while delivery and diseases of women stand in one department. Thus

CHART 3.— GYNECOLOGY — OBSTETRICS



the heads of the three departments form a natural executive body for the various interests which are intimately related in actuality and yet most loosely in our ordinary hospital management.

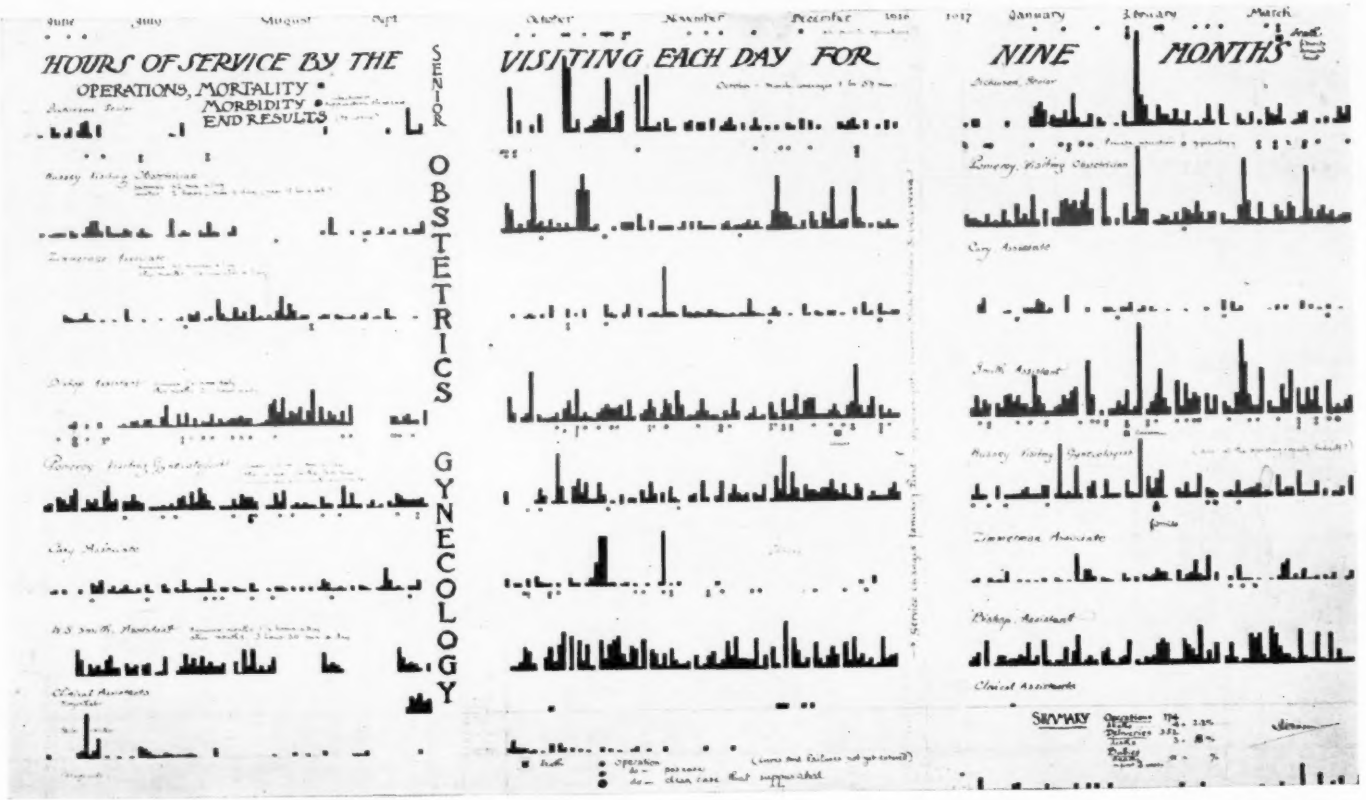


Chart 4. A study in publicity for a G.-O. staff room. Each man's work in the department, its distribution and regularity: operations, infections, deaths. (Note extreme fluctuations from day to day.)

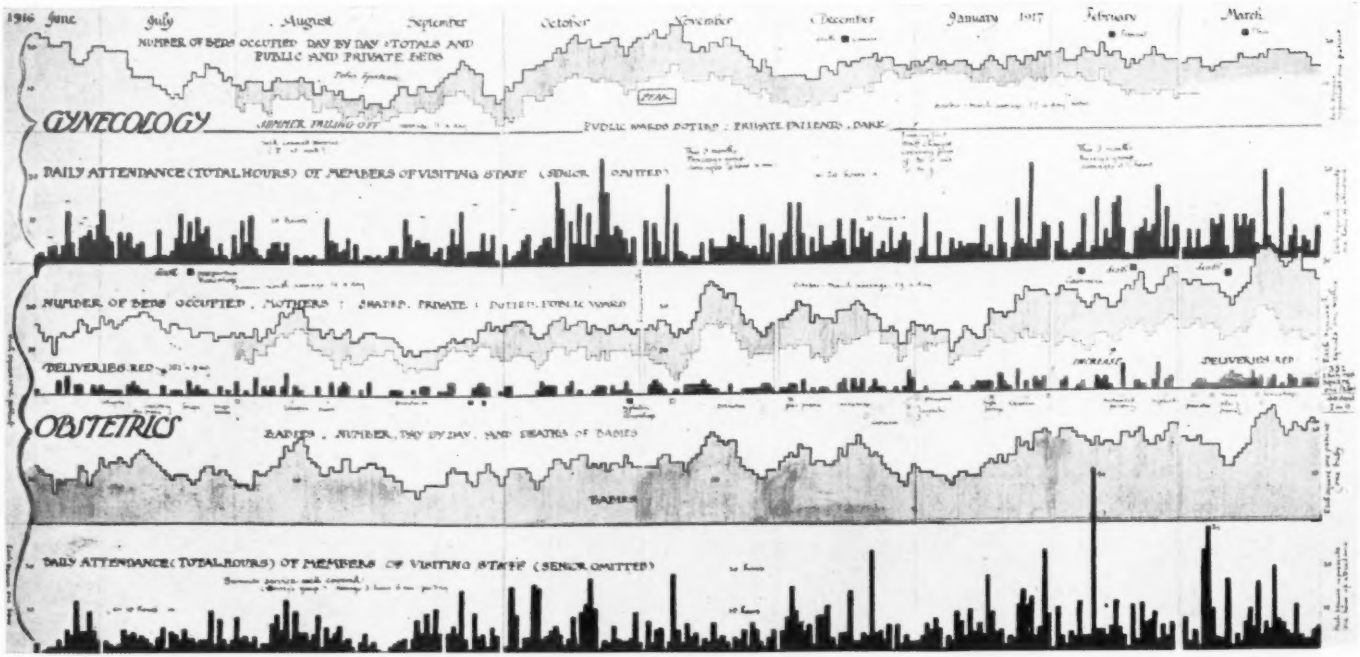


Chart 5. Peak and valley study of G.-O. service. Patients, visits by attending, 9 months labor, deaths.

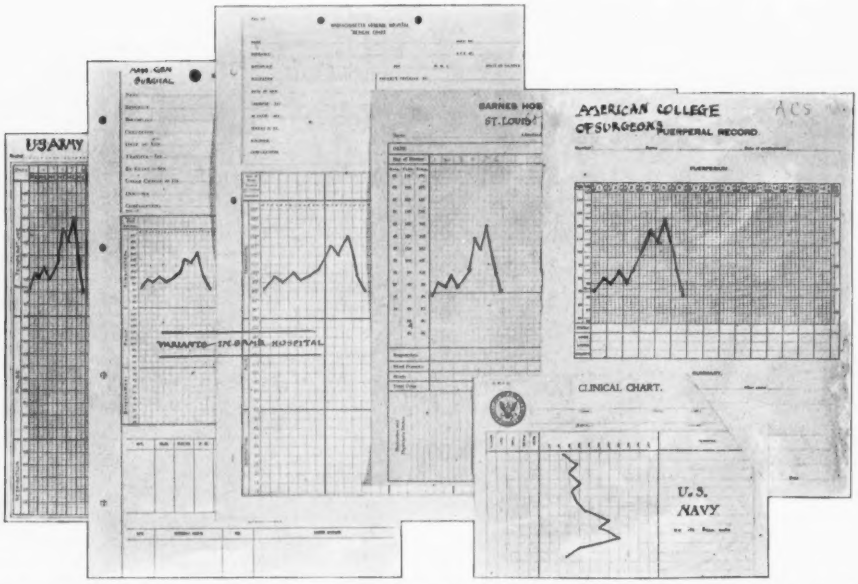


Chart 6. Various temperature charts showing the lack of standard graphic form most commonly used. They all represent the same entry and story of temperature rise and fall, yet misrepresentation and confusion inevitably result from such lack of agreement.

Chart 3 shows a completed organization in which the dispensary is integrated as it should be. That is, the older members in the dispensary have responsible junior positions in the hospital, and the dispensary is under the control of one of these men who is on the hospital staff. The upright lines show just how the delegated authority runs. In another chart, posted in the headquarters of the department, the upper men can always have before them the names of the very newest acquisitions to the bottom of the staff. In still another chart, not only are the steps of promotion shown, but the area of discretion of each individual, his duties, and his term of service. In this way, your organization and mine may be compared with no undue labor.

Charts of results. Do the suppurations run mostly against a particular man — taking of course those in clean cases — or do they begin at a certain month when the new head nurse came into the operating room, or do they occur when the crew in the operating room is changed in the process of training the nurses? Does our department run a larger series of suppurations than other surgical departments in the same operating suite? Does our department run a worse mortality and morbidity record than yours, when both are entered after the same manner? A glance at the chart answers the questions.

It is easy also for the use of symbols to make public several other things. Does the Head really inspect? Just how often does he go into his dispensary and his laboratory? Does he hold a seminar regularly? How often, and how long are his grand rounds? A symbol for each of these could be entered with very little expenditure of time. These are examples of conspicuous, accessible information.

Charts of the unchartable. It goes without saying that there are qualities like initiative, resourcefulness, tact, and common-sense that cannot be measured like temperature or attendance. Even attendance records fail to show values, for the time of the man who sticks strictly to business may be worth double that of the man who sits about and gossips, or reads a staff library. Quality is hard to put in graphic symbols. Quantity,

however, measures many things as when faithful attendance in a dispensary clinic rapidly develops it. Reprints will give no uncertain idea of the thinking and the study done by a man. Mortality and morbidity records will check reckless men if they know that pitiless publicity occurs. At any rate it may be said that in hospitals, at present, attempts like the foregoing should better present conditions, wherein there is practically no checking up of either regularity of attendance — that is, quantity, or reasons for grave failures, or errors in diagnosis, or follow-up, or progress on the part of the individual — that is, quality. If it be true, for instance, as is alleged, that a head of a joint department of gynecology and obstetrics pays practically no attention to midwifery — is almost unknown in his obstetric ward — it is very easy to see by a ward signature book and a chart what time he gives to each service. If a hospital is not studying its results at all, and if its men are publishing nothing, a charted publicity should show this up. Of course there are in your group head-workers and hand-workers, but your group, as a whole, must give evidence, not only of craftsmanship, but of study, of knowledge of the work of others through clinical travel, and of attendance at society meetings, of consultations with other departments, and of thinking on paper. Some graphic records must be shown so simple and so public that the trustee who runs may read, or even the head of the department, even he who is trying to make his fees catch up with all the years he put into pure science.

Wall charts of attendance. The nearest to a cure-all that we know is publicity. Suppose a department, in its own staff room had its secretary enter on a chart, at a cost in time that we have figured as an hour a day, the hours of attendance, the operations and deliveries, and the end-results taken from the histories, we would lay bare to each other and the trustees our actual work. I submit two charts for my department in Brooklyn Hospital, covering nine months. I hear you say, "totals and averages could be shown with infinitely less labor by footing up columns. What need then for this elaboration?" Because for the study of the distribution of the facts surfaces of frequency like this are required. Regularity of attendance — fully covering a service like obstetrics — can be shown only in a table of frequency or in one of these surfaces of frequency. Its extraordinary irregularity could hardly be otherwise demonstrated. If this is the way (Chart 4) a man's hospital work fluctuates, how can he plan his day or night with any regular hours or fixed engagements? (In this chart each horizontal unit stands for one day; the upright square represents one hour's attendance or one bed filled one day.)

Chart 5 demonstrates the only way one can watch fluctuations in the number of patients or any tendency to steady increase or decrease, or seasonal fluctuations. For such a graph to be of value, all the factors affecting the conditions in the institution must be known, such as increase of available rooms, on a given date, or a poliomyelitis epidemic that keeps private patients away, or a raise in rates. This chart shows that the summer months, notwithstanding the falling off of gynecological patients, are very well covered by the staff. It shows the obstetric demand all the year and a gratifying increase in private obstetric cases choosing to go to a new hospital that offers a maximum of privacy and convenience. The constant variants show a need of always having some empty beds ready for emergency labors. It exhibits in gynecology an interesting peak after the summer heat and vacation, and another in the rush before hot weather. It raises the question of how to eliminate the summer depression and whether we shall fill the gap by lowering prices as the hotels do.

Publicity concerning mortality and morbidity (such as suppuration in clean cases and recurrence after prolapse and retroversion operations) is keenly to be desired. Here each man is charged with his errors, and it will be done as fully as our new end-result organization can manage. Here it is seen that one gynecologist gives his associate and assistant very little operating (though the associate is noted as assiduous in attendance, and, incidentally, known to be equipped with excellent operating technique and judgment); whereas the colleague when on service divides

evenly with his staff. The high infant mortality strikes one in the face — one in nine — and opposite each dark square must stand a reason such as "eclampsia," or "prævia," or "prematurity." The senior's long vacation and an associate's two months illness, are here. Also the answer to the trustees' question whether we really use the clinical assistants. They ask, "Are you overloaded? Can you eliminate any men?" The answer may be that the whole "associate" lines in Chart 4 run very thin indeed. (These men, however, are qualified to become full visiting should the visiting fall out.)

Average requirements in hours. In summer, as Chart 5 shows, gynecological work dropped off about one-third and about equally in public wards and private rooms. The two services in the department ran singularly close together (the ratio is 15 beds filled with diseases of women, to 17 with midwifery patients) in the amount of time given to each service. For these 32 patients per day, how much service did the visiting staff do daily? They averaged a total of 12½ hours — including operations and deliveries and daily rounds and dressings. To state it otherwise, the visiting staff gave 24 minutes per day per patient in the hospital, running nearly two minutes longer for gynecology than for obstetrics. Use this study as a means for making an estimate of how much time or how large a staff a conjoint department or a single service would need. Thus we would say that in gynecology or obstetrics for every ten beds occupied you should require not less than four hours hospital service a day by your visiting staff, but that five hours would be far better and this would cover laboratory oversight, study of histories for publication, seminars, and general staff meetings, but not dispensary service other than inspection and consultation.

Proportion of beds gynecology-obstetrics may claim. Looking up a few statistics to find what proportion of general surgery is gynecology, we have covered 4371 hospital cases. Eye, ear, nose, and throat patients are excluded. Bellevue, Mt. Sinai, St. Luke's, and New York Hospitals report to the Society for Advancement of Clinical Study for the first three months of 1915 and 1917, 3063 operative cases, of which 24.5 per cent is gynecology. The Methodist Episcopal Hospital's printed report for 1916 gives 19.8 per cent gynecological cases. At Brooklyn Hospital in 1916, 19 per cent of the pay patients were gynecological, and obstetrics gave almost the same percentage. A study of the data in detail, with figures from other clinics here and abroad, is under way.

Incidentally the genito-urinary operations culled from the above 3063 operative reports were just below 8 per cent. Therefore, of the free surgical beds, gynecology may fairly ask to have one in five and a genito-urinary service one in twelve.

Standardization of charts and symbols. Are we studying to save effort by a uniform system of charts and symbols? What more forceful example could be given of the need of analysis than the lack of agreement on standards? Take the case of that graphic symbol which is more commonly employed both in general and hospital practice than any other. A doctor goes from house to institution, or from one hospital to another on his daily rounds. The same fever record plotted in different places shows such confusing discrepancy as Chart 6 demonstrates. Here, side by side, the army hospital, the American College of Surgeons, the Massachusetts General, and Barnes Hospital show a gross variation that would make any engineer scoff. For the series represents identically the same record. And in one famous hospital the chart differs in its entries between the medical and surgical wards.

Nor are our other graphic symbols in any better case. The baby weight charts present like discrepancies. In a specialty where graphic symbols could be of the widest utility we have no standard scale for diagrams of the body or its parts, for they are all sizes; no symbol that means a fracture; no symbol that stands for pus, or fluid, or flatness, or foreign body, or cyst, or tumor, or any of the hundred matters that might thus be portrayed to the very great saving of time and with enormous addition to the clarity and usefulness of our scientific records.

How such graphic symbols may become embedded in practice and generally understood of all is perhaps best instanced by the practice of map-making. Anyone used to maps understands that a horizontal line with two or three little short upright lines above it means a marsh. A continuous wavy blue line signifies a brook or river. Contour lines running in certain formations indicate steepness. The double parallel line is a road; the dotted lines running off from it, a poor road; the single dotted line, a trail or path. In charting fractures or the course of bullets or tubercular consolidation of the lung or a spreading pneumonia, there is no reason why a glance at the chart should not give instant information as to the findings, and, in many instances, as to the progress from day to day. A temperature entry could show by a dot that it was a mouth record, by a cross, that it was anal, and so forth. Medicine has made a fine start with its diagrams of the chest, after Sahli's[1] twenty year's teaching. But while Lefevre follows the Berne professor, Cabot[2] changes the symbol and in lieu of tiny circles on a chest chart to show the location of large moist râles, he uses crosses, and he may even employ the same symbol for different physical findings. Two major clinics have started to standardize letter-symbols. The Massachusetts General Hospital issues a printed sheet of nearly five hundred "Allowable Abbreviations." Many are in common use, like the Latin "p. r. n.", or "G U" for genito-urinary, "F H" for family history, or lap for laparotomy. Some are disguises, like "Den. Ven," for "denies venereal," or "Gc." for gonococcus. Also the table shows schemes like this: "Mict. $\frac{D_4}{N_2}$"—Micturates four times during day, twice at night. The Mayo Clinic, under Dr. H. S. Plummer, has long used, for certain studies, sheets with a numbering and lettering that enormously facilitate and abbreviate summaries and reports. Under "Goiter," for instance, line 11 reads:

(Normal 0, Slight 1, Moderate 3, Marked 4, Required help 5, Bed 5–6, Bed Drs. Orders D)
11. Gen. Strength –1: Durat. Loss.....2: Time Max. Loss.... Yrs....Mo....Wks. 3: Deg. Max Loss.....4: Pres. Loss .... Quadriceps Loss....

[1] Lehrbuch d. Klinischen Untersuchungs Methoden. Berne, 1913, i, 544.

[2] Physical Diagnosis, 1905. "Differential Diagnosis," 1911.

And line 36 gathers a maximum of data concerning heart murmurs with a minimum of writing.

36. 1. Murmurs — First	A P M T R	Location (APMTR)
	A P M T R b c a	Radiation (APMTR) (b)ack, (c)arotid, (a)xilla
	s p d	Time (spd) (S)ystolic, (P)resystolic, (D)iastolic
	h f w m	Quality (hfwm) (Harsh, (F) soft, (W)histling (M)usical
	1 2 3 4	Degree (1234)

These are long steps in the right direction, but they are individual efforts in a matter where there should be a general agreement. Otherwise a man may go from one hospital to another to find, perhaps, a different meaning in each for a certain letter symbol.

Chart of personal activities. Now as to the study of oneself and one's own symmetry and progress. You know whether you are saving more money, or less, than you were last year. You know, whether you are better or worse physically than last year, but what are you scientifically? Is your life haphazard, or has it some definite idea and plan? Is it really true of you and me that we are not up-to-date unless, like William Mayo, we read medical literature two hours a day, and failing to do that any given day we catch up some other day? How many hours a day can you operate and be fit? How many days in the week? What recreation pays best for the time spent?

It is possible also that charting would clear up some puzzles in office work. Study and comparison of your work and mine might be of use, but without frankness we get nowhere. For instance, if we ask the question at what rate of speed a patient may be properly cared for, then we must answer straight. The dispensaries have begun to work out the question of how many patients shall be seen in an hour to prevent a rush that does injustice to them. I believe such a dispensary rate in gynecology and obstetrics has been established at a minimum of six patients an hour, including new and old. In the office, what should we do? Personally, I cannot do better than one patient to thirty minutes, averaging one new patient to four revisiting. An analysis of the time given to the new patient showed me that the history taking was consuming between twenty and thirty min-

utes per patient, where I did any justice to the matter. A blank was gotten up and no patient now appears without having filled it out unless she is one who has come for a consultation concerning a diagnosis of pregnancy, or some very simple problem. It was easy to figure that whereas to write a history or dictate it cost at least twenty minutes, to red pencil a form, so that one's secretary could take off the summary, cost but four minutes, and this will include several questions put to the patient herself and entries made by myself. Gynecology happens to be one of the things in which there are many questions asked which forbid the presence of a secretary (even though later the secretary will have to number and catalogue, and file and index the history). Have you your secret (stenographic) code for the facts no one must know? Is a dictagraph feasible (as one New Yorker uses it) in all rooms of the office? How many examining tables are desirable, and how many dressing rooms, in order to lose no time? I use two tables. How many office hours a week are best? Who engages the nurse and arranges for the hospital room and operating hour? Do you see people without appointment, only by appointment, or some days with and some without? If you have the hatless, how separate them from the hatted? In these days of many questions over the long distance telephone that call for swift reference to the patient's history what method gets at it quickest? My "Index Visible" brings the history to my desk telephone in forty-eight seconds from the time the telephone rings in the booth in the hall. What proportion of your work is given free? Mine is 63 per cent. Does any patient get away without an opinion in writing, or the description of her operation carefully detailed in type? If so why? Have you trained your fingers in your operating motions as women do theirs in piano-playing? Have you trained your operating group as the artillery officer is training his gun crew?

Finally, are you as dissatisfied with your happy-go-lucky rule of thumb methods as I am?

An outline of how scientific management would take up a study of our problems has been given in previous papers.[1]

SUMMARY

This plea for intensive study by the authoritative national body shows that no agreement exists as to standards in nomenclature of diseases, operations or instruments, or of procedure, or of transference of skill, or of form of organization, and suggests some methods of research. Sample charts of hospital personnel of a specialist group are given. A complete graphic wall chart records the work of a 32 bed service in gynecology and obstetrics covering nine months day by day. The patients' bed days are plotted, and each man is credited with his daily attendance; while deaths, suppurations, etc., occurring during his period of responsibility, are charged against him. The average requirement is found to be, for every ten beds occupied, not less than four hours a day of visiting staff time, and five, if study of histories, seminars, laboratory oversight, and dispensary inspection are included. The proportion of free surgical beds gynecology may claim is deduced from operative averages, in hospitals, with and without a visiting gynecologist, to be one in five. Queer variants in form of temperature charts are shown and the beginnings of standard symbols and abbreviations. Private office work is touched upon — the half-hour average, the filled written history blank with which the patient enters and the written diagnosis or operation report in her possession as she departs — and many lines of inquiry are started.

[1]Dickinson, R. L. Standardization of surgery: an attack on the problem. J. Am. M. Ass., 1914, lxiii, 763–765; The "new efficiency" systems and their bearing on gynecological diagnosis. Am. J. Obst., 1914, lxx, No. 6; Hospital efficiency from the standpoint of a hospital surgeon. Boston M. & S. J., 1915, clxxii, 775–778; The practicability of ratings in appointment and promotion of members of the visiting staff. Med. Rec., 1916, May 13; The need of instructors and inspectors as hospital officers. Am. J. Obst., N. Y., 1915, lxxli, No. 3.

THIRTY CASES OF CÆSAREAN SECTION

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JUST ten years ago, I published a paper describing a series of twenty-seven labors in contracted pelves, without cæsarean section. Prophylactic version and the induction of premature labor, were the measures I then advocated, and I continued these practices with considerable success until about three years ago, when I lost three babies in close succession, the mothers recovering eventually, after dangerous and painful labors.

Since then I have adopted the plan of subjecting the patients, especially the primiparæ, to the test of labor and doing a section when satisfactory progress is not made. The success of the operation in these cases led to its use in other complications, and I wish now to submit the results. Three of the cases reported were done in the public obstetric service of the Toronto General Hospital by my colleagues, Doctors Kinnear and Scott, and the rest either in that service, or in private practice, by myself, so that the technique was practically uniform throughout the series. The cases may be grouped as follows:

1. *Obstructed labor.* a Primiparæ whose external measurements gave little or no evidence of the internal contraction, but in whom the head failed to engage before, or during the first stage of, labor. All the mothers made good recoveries, and all the babies were saved but one which died of hydrocephalus and spina bifida. One of these women went thirty-six hours in labor; yet both she and her baby made excellent recoveries. Eighteen months later she was successfully delivered of a second baby by section, having declined to risk the loss of the baby by the induction of premature labor or to suffer the preliminary labor in this second case. There were eight cases in this class.

b. Patients who by measurements or by the test of previous labors were known to have contracted pelves. In this class also there was one hydrocephalic baby which lived only for four days. All the others were alive and well. The mother of the hydrocephalic infant was in the medical ward of the hospital under treatment for tubercular knee-joint. A month after her delivery, I had to do a sub-total hysterectomy for degenerating fibroid. From this operation also she made a good recovery. There were seven cases in this class, making fifteen cases in all of obstructed labor, all the mothers and all the babies, except the hydrocephalic ones, being alive and well.

2. *Hæmorrhage.* a. Placenta prævia. Three patients were operated on for this cause, all the mothers and all the babies making excellent recoveries. Other methods of treating placenta prævia have also given good results in my experience; but where the child is viable and there is but little dilatation at the time of the hæmorrhage, section seems to me the ideal plan. The child is quickly delivered and does not run the risk of asphyxiation through pressure on the placenta. In the high incision which we use the placenta is never encountered, so mother and child escape the danger of further hæmorrhage. The risk of producing tears in the softened and highly vascular lower uterine segment is avoided; and lastly one avoids the risk of sepsis which manipulation about the placental site from below undoubtedly entails.

b. Accidental hæmorrhage. One case. This woman was sent to the hospital after having a severe hæmorrhage. She declared herself to be eight and a half months pregnant, but was, I think, less than that. She was bleeding very little when she came in and the fœtal heart was good at a hundred and twenty beats to the minute. Fifteen minutes after this examination, though no further external hæmorrhage had taken place, it became slow, irregular and almost inaudible, clearly showing internal hæmorrhage. The os was tightly contracted and would not admit a fingertip. On opening the uterus a large black clot, equivalent to about a pint, burst

out of the incision, followed by a few ounces of fluid blood, and then the membranes bulged up into the wound. The placenta had been almost entirely separated. The mother made a good recovery, and the child, which weighed three pounds and a half, lived a week.

3. *Toxæmia.* a. Eclamptic toxæmia of pregnancy. In this class I lost two mothers and two babies out of seven cases. Delivery was effected in this way because the os was not dilated nor soft, and treatment had failed to prevent or control convulsions. One of the fatal cases was admitted to the hospital after having several convulsions. She was totally unconscious and had a high temperature at the time of operation. Both mother and child died. The second fatal case was that of a woman who was suffering from toxæmic blindness, and who had many convulsions before coming to the hospital. She lived two days and a half, and then succumbed, apparently to the toxæmia. The child lived. In a third case the mother lived but the child died of convulsions. Another woman did not have convulsions, but developed sudden blindness and other toxic symptoms before the onset of labor. As her symptoms were urgent and her pelvis small we preferred section to the induction of labor. She made a good recovery. I feel that the women who died would probably have died whatever method of treatment had been adopted at the time I first saw them, and that earlier section in the other cases forestalled the danger of their reaching the same hopeless state.

b. High blood-pressure from toxæmia, with acute œdema of the lungs. This was the case of an out-of-town patient who came to the city a month before delivery was due. I found her the next morning feeling very well, but showing slight albuminuria and a systolic blood pressure of 200, and sent her to the hospital for treatment. That evening, while talking cheerily to her husband, she suddenly developed great dyspnœa and œdema of the lungs, and in fifteen minutes her life seemed in danger. Morphine, atropine, camphor, strychnine and oxygen were tried in succession giving but little relief. I wanted to do a section, but a skilled anæsthetist declined to give an anæsthetic in her condition. I ruptured the membranes, and the relief of diaphragmatic pressure thus obtained gave her relief for some hours. The dyspnœa again became urgent and I did a section under local anæsthesia and gas and oxygen. The operation took fifteen minutes. She was again relieved for a few hours, but postoperative distention set in and she died of suffocation, the lungs having completely filled up. The child lived only a few hours. My colleague, Dr. Scott and I have published a fuller account of this and a similar case which I saw in consultation with him, so I shall not enlarge upon it here.

4. *Vaginal sections.* The remaining three cases were vaginal hysterotomies. One was performed on a profoundly toxic patient after several convulsions. She did not long survive the operation. Another was performed on an emaciated and profoundly toxic patient, about five months pregnant, who came in with a diagnosis of pyelitis and pernicious vomiting. For a time she seemed to improve, but later she sank gradually into a comatose condition and died at the end of a week. The autopsy showed tubercular kidney. The uterine wound and cavity were healthy.

The third was operated on under gas and oxygen anæsthesia, for pernicious vomiting. She made a good recovery. I believe that this last described procedure is the best method of emptying the uterus in grave cases of pernicious vomiting. If the vagina be patulous and the uterus low, it is an easy operation. If the vagina is small and the uterus high it may be very difficult; and it has but little application after the sixth month.

One of my cases had a severe rigor and a temperature of 106 degrees on the fourth day. I removed a small piece of membrane from the os, and gave an intra-uterine douche, after which she remained perfectly well. Three patients I delivered a second time by section, they all preferring that method to taking the chance of losing the baby by the induction of premature labor. In one case there was considerable adhesion of omen-

tum to the abdominal scar; in the others nothing but a few thread-like adhesions here and there. The uterine scar was faintly visible and palpable in all. In one of them it was evident as a furrow when the uterus contracted, but this seemed rather to be due to the rising up of muscle alongside of the scar, than to any yielding of it. The patient who had the rigor, as described above, at the first operation, I sterilized eighteen months later at her second delivery as she and her husband requested it. This was done by excising the tube from the uterine cornu and stretching the uterine peritoneum over the wound. The peritoneum covering the distal portion of the tube was stitched over the cut end of it. In these three cases the union was stout and would, I judged, have stood considerable strain.

It has been objected that if one delivery be by section, all subsequent ones must be by the same method. My late colleague, Dr. Fenton and I, have each had cases of women, however, delivering themselves naturally at a second labor when the first had been by section; nor does a repeated operation seem to be more dangerous than a first one. These points I have discussed in a previous paper. It is difficult to estimate what the danger may be of rupture at a second labor when the condition found at the first operation and the technique used are not described in detail. I venture therefore to append a description of the method used throughout the abdominal cases of this series.

The skin incision, about three and a half to four inches in length, is made wholly above the umbilicus. Thus when the uterus is emptied and sinks down there is no danger of adhesion between the abdominal and the uterine scars. The uterine incision is longitudinal, from near the top of the uterus downward for from three to three and a half inches, in the median line, no attempt being made to avoid the placenta. I do not go directly through with the first cut, preferring to work through into the uterine cavity with the handle of the knife, so as to avoid injury to the child or cord. With scissors the incision is then completed to the full length. Sometimes the dextro-rotation of the uterus is so great that the left tube appears in the abdominal wound, and some manipulation is needed to make the median line accessible. Care must be taken to cut at right angles to the surface, otherwise a shelving incision is made, and good apposition not so easily secured. While the child is being removed an injection of one cubic centimeter of pituitrin is given in the gluteal region. I prefer this to injecting it straight into the uterine muscle as being a less dangerous and equally efficacious method. After the removal of the placenta, the interior of the uterus is gently rubbed over with gauze to ensure the complete removal of the membranes. In one case in which there was but little dilation of the os I pushed a thick strand of iodoform gauze down through the cervix as a drain and removed it next day, *per vaginam*. I have not repeated this practice. The uterine incision is closed by three layers of sutures. The first of interrupted sutures of No. 2 chromic gut through the muscle layer only. I prefer this to the continuous suture which some of my colleagues like. The next layer is a continuous suture of No. 1 chromic gut which unites the superficies of the wound. The needle is made to enter and emerge close to the edge of the incision, thus making the closed wound a narrow line over which the visceral peritoneum is easily drawn by a continuous Lembert suture of No. 1 chromic gut. A scar in this situation is not so liable to strain and stretching as one in the lower uterine segment would be. The liability to rupture is therefore less. In closing the parietal peritoneum the edges are everted so that peritoneum is applied to peritoneum, and adhesion is less likely to take place between the scar and the viscera or omentum.

In conclusion, I may add, that when the time of the operation is known, I have made it a practice, in the last two or three cases, to administer some form of lactic acid bacilli tablets for the week preceding, and have had much less trouble with intestinal distention after operation.

STUDIES IN PALEOPATHOLOGY

Pathological Evidences of Disease Among Ancient Races of Man and Extinct Animals[1]

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INVESTIGATION of the evidences of disease among ancient races of man and his predecessors, the early vertebrates, is limited to an examination of the lesions on their skeletal remains. The present study, therefore, may be regarded as a contribution to bone pathology. Since the diseases evidenced on the skeleton are only a small fraction of the maladies which the individuals of past ages must have endured, paleontological evidences give us but a faint idea of the prevalence of disease among the early races. The lesions on the bones, however, show a variety of interesting phenomena, into the nature of which it will be interesting to inquire.

Origin of term paleopathology. Sir Marc Armand Ruffer during his studies of the evidences of disease among the ancient Egyptians, as seen in their mummies, applied the term *paleopathology* to the new science he was developing. His studies were received with the greatest favor, and have aroused widespread interest. An extension of the subject is to be found in the study of the evidences of disease among the remains of the ancient races of man, Pleistocene mammals (such as the cave bears and other associates of the stone age man), and the still earlier races of mammals, reptiles, amphibians and fishes, the history of which covers many millions of years of geological time. This paper will deal with a discussion of the evidences of disease among these early races, with a statement of the general significance of such a study.

Diseases of the ancient Egyptians. It is not necessary here to outline the studies of Ruffer and his associates on the pathology of the ancient Egyptian mummies since their essays are readily accessible and there have been several reviews of this work published. The pathological conditions (Figs. 1 to 8) which are encountered are many: Pott's disease, small pox, deforming arthritides of many kinds, tuberculosis, arteriosclerosis, fractures of many kinds, necroses, caries, alveolar osteitis, tumors and other interesting lesions may be discerned.

Arteriosclerosis in the aorta of the Pharaoh of the Exodus. The value of the study of mummies has been as important from an historical as from a medical standpoint. As an evidence of the community of interest between history and medicine may be mentioned the studies of Shattock and Ruffer on the pathological anatomy of the aorta of King Merneptah, the reputed Pharaoh of the Exodus. The sections of this aorta show the picture of typical senile calcification, the bony, parallel, elastic lamellæ being perfectly preserved, and the intralamellar material thickly strewn with calcium phosphate. The mummy was found in the tomb of Amenhotep II, who reigned in Egypt from 1448–1420 B. C., at Thebes, and was unwrapped by Dr. G. Elliot Smith, who sent the aorta to the Royal College of Physicians of London. The finding of Merneptah's mummy at Thebes, of course, discomfited the adherents of the theory that as the Pharaoh of the Hebrew Exodus, he must have been drowned in the Red Sea.

Merneptah's appearance and bodily condition. That Merneptah, who reigned in Egypt from 1225–1215 B.C., thirteenth son and successor to Ramses II (1292–1225 B.C.) was a man of great age is shown by his baldness, the whiteness of the little hair left, the complete ossification of the first rib, not its sheath alone, and the calcareous patches of the aorta. Only one tooth was visible, the upper right median incisor. Although the body was reduced to little more than skin and bones, the redundancy of the skin of the abdomen, thighs, and cheeks indicate that Merneptah was a somewhat corpulent old man.

Disease among the Pre-Columbian Indians of North America. A study of the pathological

[1] Read before The Chicago Surgical Society, April 5, 1918.

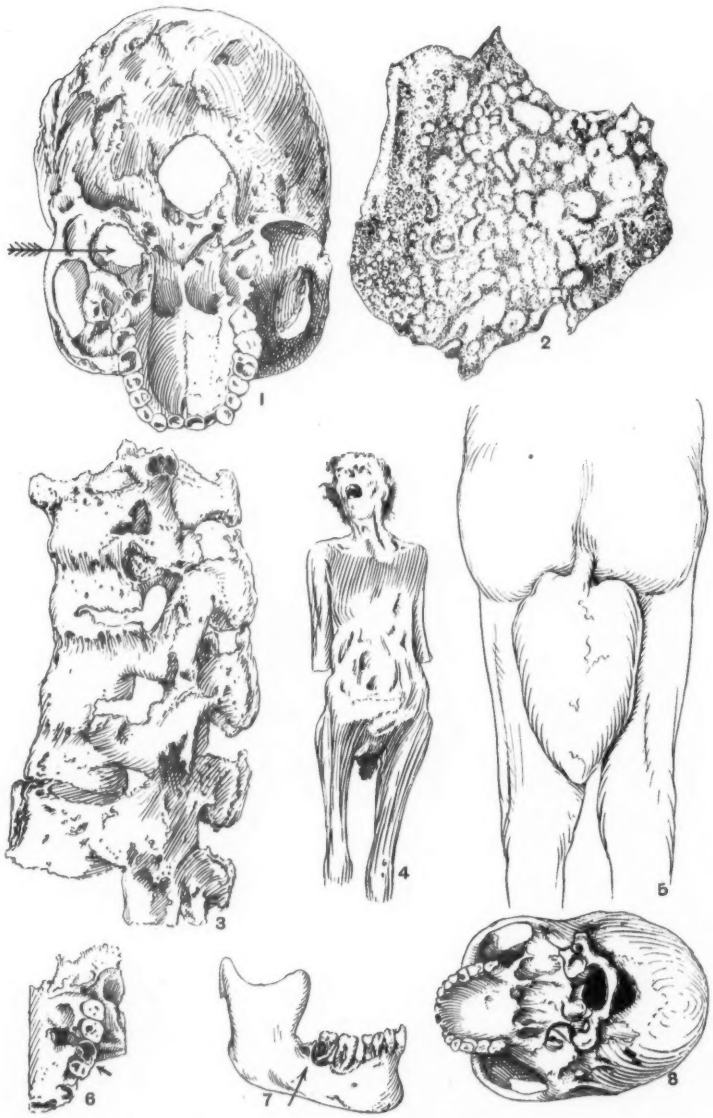


Fig. 1. Skull of ancient Egyptian, showing erosion due to a carotid aneurism. (After Smith and Jones.)

Fig. 2. Portion of the skin of a mummy of the Twentieth Dynasty, 1200–1090 B.C., with an eruption resembling that of variola. (After Ruffer and Ferguson.)

Fig. 3. Ankylosed lumbar vertebræ of an Egyptian mummy, due to osteo-arthritis. (After Smith and Jones.)

Fig. 4. A male mummy of a Christian (Coptic), 400–500 A.D., showing prolapse of the rectum. (After Ruffer.) The body came from Antinoe in upper Egypt.

Fig. 5. Portion of the body of a girl from the Byzantine cemetery, showing anal, or vaginal prolapse of the viscera. (After Smith and Jones.)

Fig. 6. Maxillary bone of an Egyptian (Coptic), 400–500 A.D., showing the effects of caries and necrosis of the palatum durum. (After Ruffer.)

Fig. 7. Mandible of an Egyptian (Coptic) mummy, 400–500 A.D., showing the effects of caries and pyorrhœa alveolaris. (After Ruffer.)

Fig. 8. Skull of an Egyptian, showing ankylosis of the atlas to the skull, as a result of spondylitis deformans. (After Smith and Jones.)

Fig. 9. Adult pre-Columbian male skull from the valley of the Chicama River, Peru, showing recovery from and the remains of symmetric osteoporosis in infancy. (After Hrdlička.)

anatomy of the early North American Indians and of the ancient races of South America would doubtless furnish very interesting material. A complete account of the pathological lesions found in these races has not yet been given but occasional discussions of the evidences of disease among these peoples are to be found in the anthropological literature dealing with the subject. A survey of this literature gives an interesting insight into the possible conditions of these peoples as regards disease. We owe the majority of the studies on this subject to Aleš Hrdlička and one of his figures of an Incan skull (Fig. 9) showing the effects of symmetric osteoporosis in infancy, and the recovery therefrom, is published herewith. Eaton has stated that syphilis is evident in the skeletons of the later Incas (pre-Columbian of about 1400–1550 A.D.) and has given some excellent figures of these lesions. His results are discussed below.

Hrdlička (3) and Langdon (4) have studied the evidences of pathological processes among the remains of the early North and South American Indians, but their results have not been summarized. From a brief survey of these studies it appears probable that the early inhabitants of the Western Hemisphere were singularly free from disease of any kind, so far as we may judge from the remains which are available for study. The indications of syphilis among early North American races have been reviewed by Lamb (5). He finds from a review of the literature and a study of new evidence that the indications of syphilis among the pre-Columbian races of America are inconclusive, agreeing with the opinion expressed by Virchow at about the same time.

Syphilis among the Incas. Eaton (6), however, is very decidedly of the opinion that syphilis was present among the pre-Columbian Peruvians, and in a radiograph of a young male left tibia he shows what he regards as evidences of "extensive syphilitic disease." On other skeletons he has discussed the existence of syphilitic lesions in adults of both sexes, as well as in the "skull of a child about 7 years of age, presenting syphilitic necrosis of the frontal bones, and an abnormal condition of the metopic suture." Some of Eaton's figures (Figs. 10 to 13) are published herewith. Concerning the child's skull Eaton says: "The skull and lower jaw of a child about seven years of age, from this grave, are chiefly interesting pathologically, the destructive process of inflammatory disease having resulted in two perforations of the frontal bone. One lesion is situated low on the frontal bone, a little to the left of the mid-line, and the other on the right near the coronal suture. In both these lesions the destruction of the inner table has advanced widely beyond the limits of the perforations; in fact the two lesions are thus connected endocranially. There is also to be noted a similar destruction of the inner tables of the parietal bones along the anterior part of the sagittal suture. The assumption that these lesions are syphilitic is based on the above-described conditions, which are more likely to be observed in the syphilitic subject than in any other." Especially is this likely to be the case when accompanied by the destruction of the nasal point. Eaton's figure, a photograph, is not conclusive.

Syphilis in Egypt. Syphilis has been reported to occur among the ancient Egyptians,

Fig. 10. Right femur of an adult, female, pre-Columbian Incan found in a cave of the Machu Picchu region, Peru. The bone appears free from disease and is published for comparison with the next femur. About 1400 A.D. (After Eaton.)

Fig. 11. Left femur of the same skeleton, showing extensive syphilitic periostitis. The fracture was produced after the bone was found. (After Eaton.)

Figs. 12–13. Skiagrams of the right and left femora of the same skeleton, antero-posterior view. (After Eaton.)

as cited by De Morgan (12), although the evidence he presents is inconclusive. De Morgan cites the work of Fouquet (13), who initiated the study of the pathology of the ancient Egyptian mummies.

Lortet and Gaillard (14) in their study of the fauna of ancient Egypt as seen in the mummified remains of the sacred animals preserved by the ancient Egyptians, such as birds, lizards, crocodiles, antelope, bulls, dogs, cats and other forms of vertebrates, have reported lesions of syphilis on the skull of a young woman. The lesions take the form of irregular erosions in the outer table of the frontals and the anterior parts of the parietal bones.

Evidences of syphilis among early human races. In studying the evidences of syphilis among early human races it is very important to keep in mind the nature of the fossil bones of extinct mammals which show hyperostoses and carious roughenings and thickenings which, from an external examination, usually show the same pathological features as do the syphilitic bones of recent man, where the diagnosis is made at autopsy. Virchow called attention to this similarity in his paper on the history of syphilis and he described and

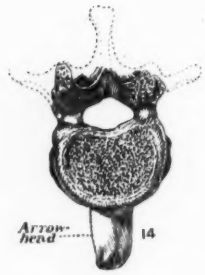
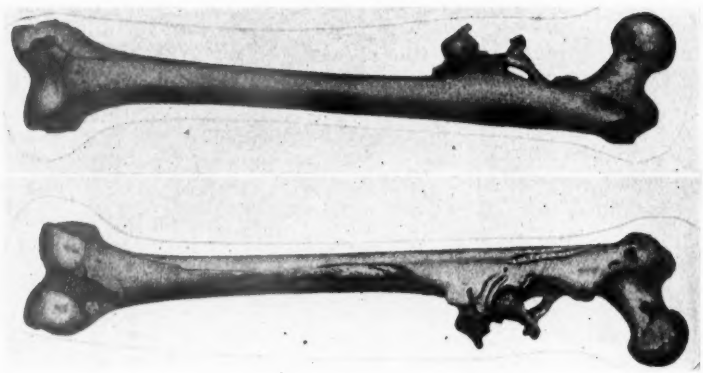


Fig. 14. Lumbar vertebra of a late stone age man, showing a stone arrow point embedded in the visceral surface. The stone age hunter was shot either purposely by an enemy, or accidentally by a companion. The arrow point entered the abdomen near the umbilicus and the man died shortly afterward. The vertebra is many thousands o years old and was found by Déchellete from whose photograph the figure is made. (After Breasted.)

Fig. 15. Portion of a rib of an ancient bull which lived at about the same time as the stone age hunter whose vertebra is shown in Fig. 14. The injury evident on the rib may have been produced by the arrow point of a stone age hunter, since there are indications of other injuries on the skeleton. We may picture a hunt which took place ten thousand or more years ago between stone age man and ancient bull, who finally succumbed after several attacks and sank to the bottom of a lake in which he took refuge from his pursuers. Here thousands of years later his skeleton was found and mounted in the museum at Copenhagen. (After Breasted.)

Fig. 16.



Figs. 17 (above) and 18.

Fig. 16. Left ulna of an ancient man, known as the Neanderthal man, whose skeleton has aroused considerable interest because of the primitive characters which it exhibits. This skeleton which is about 50,000 years old shows evidences of an injury in the divaricate olecranon, possibly due to a fracture. Drawn from a photograph of the original by Hrdlička.

Figs. 17 and 18. Anterior and posterior views of the left femur of *Pithecanthropus erectus*, a precursor of man, portions of whose skeleton, 500,000 years old, were found in 1891 in a river deposit in Java. The femur shows an extensive medial exostosis due to some chronic infection or irritation the cause of which has not been determined. (After Dubois.)

figured very carefully the hypertrophied radius of a cave bear (Fig. 22) which resembles very closely the carious roughening and enlarged condition of the Peruvian femur (Figs. 10 to 13). Virchow applied the term "Hoehlengicht" or cave-gout, to some of the lesions of the cave bears, referring especially to the lesions of spondylitis deformans which are very abundant among the remains of Pleistocene mammals. In making a diagnosis of syphilis on the limb bones alone, one may be led astray unless the above mentioned considerations are kept in mind.

Among the North American Indians, indications of syphilis have been cited by Langdon, but his diagnosis has not been confirmed. Diseases in general are rare among the early races of America although Hrdlička has mentioned several indications of pathology in many of his papers and has figured especially the ankylosed vertebræ of a southern Indian from Louisiana, showing the results of spondylitis deformans. Under Hrdlička's direction, there has been assembled at San Diego a well arranged collection of early Indian skeletons showing evidences of

disease, but no description of these lesions has yet appeared.

The evidences of disease among the late stone age (neolithic) and the older stone age (paleolithic) races of man have been studied by Raymond (1), and Le Baron (2). Mention of sundry pathological lesions has also been made by Keith (15). These studies are necessarily based on the remains of human races which occupied European countries since no representatives of these groups of people are to be found in the Western Hemisphere.

Disease and injury among the Stone Age men. The remains of the stone age men of Europe occasionally show evidences of disease and injury. One of the most interesting cases of injury in an early man is a specimen of a lumbar vertebra showing a stone arrow point embedded deeply in the visceral surface (Fig. 14). The individual was shot through the abdomen and the arrow must have been coming with terrific force since it penetrated the abdominal wall near the umbilicus, plowed its way through the viscera, and embedded itself so firmly in the body of the vertebra that it has remained fixed after thousands of years. The individual may have died of peritonitis or he may have died from some other cause, but there is no indication that he lived a great while after he was shot, since there is an absence of callus around the wound.

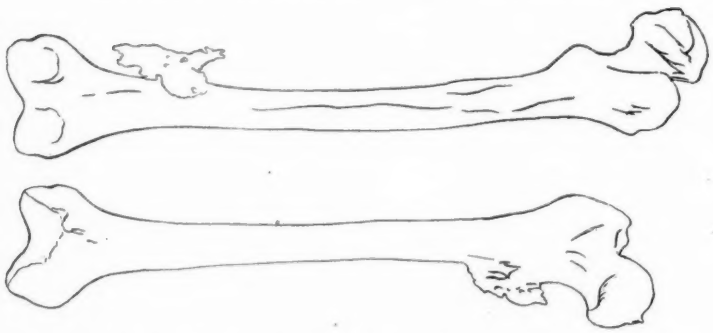
A skeleton of an extinct buffalo or wild bull, as mounted in the museum at Copenhagen, shows some rib injuries (Fig. 15) doubtless inflicted by the arrow points of stone age hunters. Other evidences of disease and injury may be found in the archeological literature and collections. Mention will be made of these elsewhere.

Early indications of trephining among ancient man. The fact that early man performed the operation of trepanning or trephining indicates the presence of diseases in the brain, either tumors or infections, regarded by early man as due to the presence of an evil spirit. By scraping the skull with obsidian knives, they perforated to the dura mater and allowed the endocranial pressure to be relieved. The operation might have been performed for the relief of a depressed fracture, or was, perhaps, purely ceremonial and not therapeutic at all. The procedure must have been excruciatingly painful and one wonders at the relative frequency with which it was performed. Keith (15) has described and figured a skull from a Neolithic (30,000 years ago) sepulchre in France, which had been trepanned, doubtless by scraping with a flint, in three places. The patient had recovered for the margins of the openings were healed over. The operation was widespread and evidences of it are found in nearly all portions of the globe. The ancient Peruvians performed it often. Fletcher (16) has reviewed the entire subject of trepanning among ancient races and has given other interesting evidences of prehistoric surgery and infections.

Fractures and disease among the Neolithic men of France. Further evidences of disease among the ancient stone age men have been given by Paul Raymond (1), who has described and figured in the remains of Neolithic man of Europe cases of spondylitis deformans, arthritis of the knee, congenital luxation of the femur, fracture and repair of the femur with the formation of callus. He also reports syphilis in Neolithic man, 30,000 years ago, as evidenced in a pathological humerus and radius. His diagnosis, however, is open to criticism since we have no evidence that syphilis can be differentiated on such findings as he has reported.

Raymond reports that all types of fractures are to be found on the prehistoric bones he studied. He discusses the frequency of arthritis deformans on the skeletons of these ancient races, attributing this deformation to the fact that Neolithic man lived in caves, but he failed to note that the ancient Egyptians who did not live in caverns were afflicted with the same disease. Spondylitis deformans also occurs among the animals of Egypt as seen in the embalmed remains. Raymond also refers to neolithic evidences of Pott's disease, and scoliosis.

Fracture of the ulna of the Neanderthal man. The most famous of the skeletal remains representing early fossil man are the portions of a skeleton of an extinct species of man found in a cave in the Neanderthal, in the



Figs. 19 (above) and 20. Modern human femora showing exostoses similar to those exhibited by the *Pithecanthropus*. (After Virchow, based on specimens in the Berlin Pathological Institute.)

Rhine province of Prussia, and fully described by Schaafhausen in 1857. Some of the skeletal elements show pathological lesions. The proximal end of the left ulna (Fig. 16) doubtless had suffered fracture of the olecranon, which had healed with a widening of the articular fossa. The left humerus shows signs of an injury in consequence of which it doubtless remained much weaker than the right bone. Caries has been said to be evidenced on the occiput but this has been denied by Schwalbe. Among other pathological processes seen in the skeletal remains of ancient man in Europe may be mentioned alveolar fistulæ, necroses, and arthritides. Dental caries is very rare among early human races, although occasionally teeth are lost not from caries, but from abscesses (gum boils) forming at their roots, as has been reported by Keith (15) in a Paleolithic Englishman, who lived 40,000 years ago.

Pathology in the oldest man-like form (500,000 B.C.). The oldest well-authenticated skeletal remains of man or man's precursors on earth were found in 1891–2 by Dr. E. Dubois, then a surgeon in the Dutch Army, while engaged in paleontological excavations along the left bank of the Bengavan River, near Trinil, in the central part of the island of Java. These important remains were described by Dubois (7) and his work was immediately received as one of the greatest contributions to the study of the antiquity of man. A rather extensive literature has grown up around these remains, to which an age of half a million years has been assigned. The interest to us in these curious remains is that the left femur, which was found entire, shows marked exostoses indicating the presence of a pathological condition.

Under the leadership of Rudolf Virchow, on December 14, 1895, there was called a special meeting of the Berlin Gesellschaft fuer Anthropologie, Ethnologie und Urgeschichte to consider especially the remains of *Pithecanthropus erectus*, as these elements of man's precursor were called. Attention was called by Dubois, Kollmann, and Virchow to the exostoses on the femur. Virchow read a paper (8) in which he showed that the pathological condition (Figs. 17 and 18) in the extinct form was similar to exostoses in recent human skeletons, and he exhibited examples (Figs. 19 and 20) of such diseased bones from the collections of the Berlin Pathological Institute.

This ancient form represents the oldest human type, and the above review of the ancient human races shows that in every race and in every country some evidences of disease are present, although one is struck by the scantiness of the evidence of disease as compared with the abundance of remains available for study. A study of the remains of these early races leads us to no conclusion regarding the origin of disease. Since we find the remains of Pleistocene mammals, which were associated with ancient man also diseased, it may be well to see what the condi-

tions of disease are among the ancient races of mammals, many thousands of years ago.

Pathology in the cave bears. The literature on the pathological conditions of the Pleistocene mammals is rather extensive, though scattered, and only brief references will be made to it in this place. Diseased conditions among the cave bears were first noted in 1774 by Esper, who described what he regarded as an osteosarcoma on the femur of a cave bear. Mayer (9), however, restudied the specimen and regarded the lesion as a fracture (Fig. 21) with necrosis and callus, but the specimen has never been adequately described. Of the fifty papers published which make mention of the pathological conditions of fossil animals eighteen of them deal with the diseased nature of the skeletons of Pleistocene mammals, chiefly the cave bears which were very abundant in Europe. The diseases of the cave bears cover a wide range, as may be seen from the observations of the surgeon Walther (10) who described numerous fossil Pleistocene bones showing pathological lesions. Walther was much impressed with the undoubted evidences of disease thousands of years old. A right femur of a cave bear (Fig. 21) exhibited extensive necrosis with widespread roughening of the bone. He observed also co-ossification of two dorsal vertebræ (Fig. 28) due to arthritic lesions; caries in the left mandibular ramus, especially extensive in the alveolar fossæ and processes of the canine and molar teeth, resulting in extensive absorption of the processes, similar to the modern results of alveolar pyorrhœa. Another mandibular ramus exhibits a heavy thickening of the processus alveolaris associated with an extensive carious surface, and numerous osteophytes. A lumbar vertebra is widely necrosed by caries, which Walther assigns to tuberculous spondylitis. Various types of fractures and infections, indications of osteomalacia, an atlas ankylosed to the skull, atrophy and other pathological conditions are seen among these old cave animals which lived and died hundreds of thousands of years ago.

The majority of the lesions described by the writers on the pathology of the animals of this great period were regarded as due to some form of traumatism. Some are regarded by Walther as due to the weather, such as gout (Hoehlengicht) and other arthritic lesions. Concerning the cause of disease Walther concludes his paper with this philosophical statement: "We have no historical data to prove how old disease is nor when it first attacked the poor sinful human race. In every case diseases are the faults of inheritance, and since they are visited upon the sons and daughters because of the sins of their fathers, they are true sins of inheritance." How Walther would apply this philosophy to the cave bears is not clear.

Fig. 21. Left femur of a European cave bear, 500,000 years old, showing an oblique fracture of the lower portion of the shaft with various necrotic sinuses. The bone had healed with little or no shortening. (After Mayer.)

Lesions similar to those seen among the cave bears are to be found among Pleistocene mammals of California. The Rancho la Brea beds near Los Angeles have furnished many interesting skeletons of wolves, elephants, saber toothed tigers, sloths, and birds, many of which show evidences of disease or injury. These skeletons are found entombed in asphalt so that the nature of the bones is unchanged, and one is able to study the lesions as if they were recent bones. A few of the diseases and accidents are shown in Figures 32 to 36.

Tabular view of the Pleistocene. A tabular view of the Pleistocene, the last geological period just preceding the period in which we are now living, is given below. The Recent Period began 25,000 years ago so that the Pleistocene has ended long ago. The Pleistocene witnessed the origin and evolution of man and the extinction of certain groups of mammals. This is the most important geological period in the history of man, for in it the foundations of our modern civilizations were made.

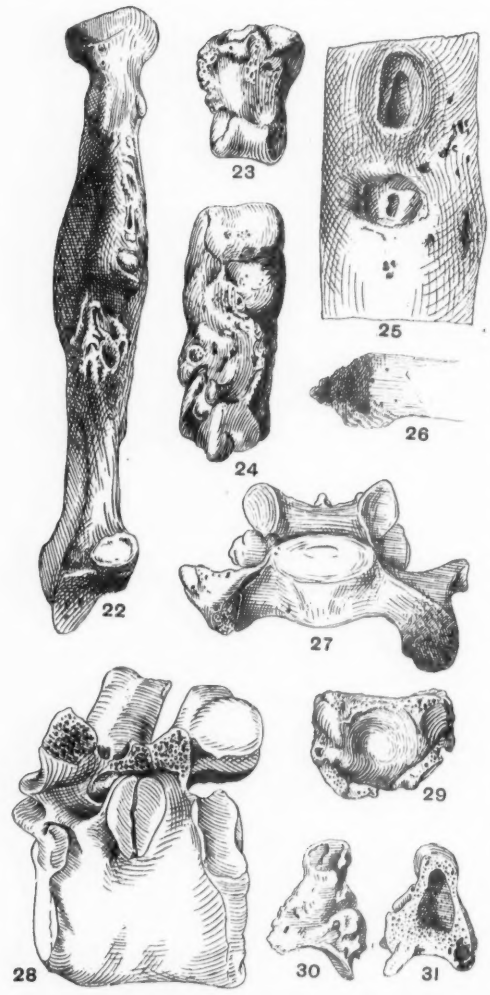


Fig. 22. Left radius of a cave bear from Moravia showing extensive enlargement and carious roughening. Around this ulcerous surface, the bone is covered with strong, hard, although somewhat porous growths, which are drawn about the bone posteriorly. The interest in this diseased bone, which is a common type among the cave bears, is intensified by the similarity to the so-called osseous lesions of syphilis found in pre-Columbian human skeletons in North and South America. (After Virchow.)

Fig. 23. Phalange II of a cave bear from Austria, showing a carious roughening and exostoses. (After Schlosser.)

Fig. 24. Metacarpal II of a cave bear from Austria, showing arthritic lesions and carious roughening. (After Schlosser.)

Fig. 25. Portion of femur of cave bear, shown in Fig. 21, showing necrotic sinuses. (After Mayer.)

Disease and injury among ancient mammals. Evidences of disease older than the Pleistocene are numerous and extend back into geological time for many millions of years. The evidences for such a statement are to be seen in the lesions of the fossil remains of the races of animals whose skeletons are preserved in the rocks. The nature of the evidence is necessarily slender since it is entirely osteological. A brief discussion of some of the diseased bones of fossil mammals may be of interest.

The most interesting example of duplicate exostoses (Figs. 38 and 39) seen among fossil mammals is found on the right and left radius of *Daphænus felinus*, an early dog from the Oligocene of Nebraska. The skeleton of this interesting dog is described by Hatcher (11) and the drawings shown herewith are taken from his memoir. The nature of the lesion may be seen from an examination of the figures of the right radius (Figs. 38 and 39). If parallels for this interesting case exist among human skeletons a comparison would be interesting.

Osteomalacia, or some similar disease is evidently the cause of the lesions seen in the tibia, fibula, and tarsal bones of *Limnocyon potens*, an early carnivore from the Washakie Eocene, nearly 3,000,000 years old. These bones show considerable exostoses which may have been due to an infection of some duration or to nutritional disturbances.

The nature of fractures among early mammals may be seen from an examination of the left leg of *Aeleurocyon*, a carnivore from the Lower Miocene of Wyoming. The animal had suffered a complete, oblique fracture (Fig. 37) of both fibula and tibia and the injury became infected with resulting necrosis and the formation of osteophytes. Fractures of many

Fig. 26. Portion of a fractured rib of a cave bear, showing callus. (After Virchow.)

Fig. 27. Sacral vertebra of a cave bear, showing an hypertrophied, transverse process. (After Virchow.)

Fig. 28. Spondylitis deformans in the vertebræ of a cave bear. (After Mayer.)

Fig. 29. Cervical vertebra of a cave bear, showing in posterior view, the lesions of spondylitis deformans. (After Schlosser.)

Figs. 30 and 31. A diseased phalange of a cave bear shown in lateral view and in section. (After Virchow.)

TABULAR VIEW OF PLEISTOCENE PERIOD

Geological Period	Stone Cultures and Cold Periods	Division	Human Types	Animal Types
			Modern races	Recent faunas
RECENT duration 25,000 years.	Bronze age Neolithic	Prehistoric Neolithic	Ancestors of modern man	Reindeer period
	Azilian-Tardenoisan Magdalenian Solutrean Aurignacian 25,000 years[1]	Upper Paleolithic	Grenelle Cro-Magnon Grimaldi	
	Mousterian 50,000 years Acheulean 75,000 years Chellean 100,000 years Pre-Chellean 125,000 years	Lower Paleolithic	Neanderthal (Krapina) Piltdown Man	Ancient horses elephants, hippopotami, wooly rhinoceros, hairy mammoth, lions and bears.
PLEISTOCENE DURATION 500,000 years	Third Glacial Period. 150,000–200,000 years			
	Second Interglacial Period. 200,000–350,000 years			
	Second Glacial Period. 350,000–400,000			Cave bears and their associates.
	First Interglacial Period. 425,000–450,000 years		Heidelberg Man	
	First Glacial Period 475,000 500,000 years			Saber toothed cats. Ancient horses and elephants. Extinct mammals.
			Man's precursor Pithecanthropus (Trinil)	
PLIOCENE duration 500,000 years	525,000 years from the close of the Pliocene to the opening of the Recent			Extinct mammals.

[1] This indicates 25,000 years prior to the Recent Period, which has tself persisted for 25,000 years.

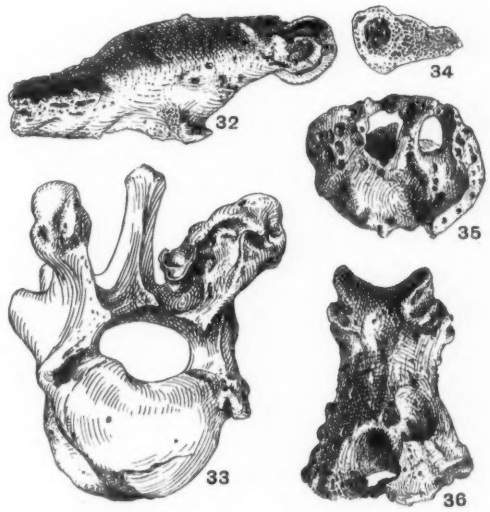


Fig. 32. Metacarpal of a wolf from the Pleistocene, Rancho la Brea beds of California, 500,000 years old, showing a fracture, with callus and exostosis. A section through the fracture is shown in Figure 34.

Fig. 33. Lumbar vertebra of a saber toothed tiger cat from the Pleistocene, Rancho la Brea beds of California, showing an hypertrophied process as seen on the right side.

Fig. 34. Section through the fractured portion of the metacarpal shown in Fig. 32.

Fig. 35. End view of the phalange of a wolf from the Pleistocene of the Rancho la Brea beds of California, showing the erosions of osteomyelitis (?) and other necrotic indications.

Fig. 36. The same bone from a dorsal view, showing the erosions above mentioned, and the carious roughening of the surface.

kinds are especially numerous among fossil animals, and the results in healing are quite comparable to those in modern human bones.

Dental caries among extinct vertebrates. Dental caries (Fig. 41) is often met with among fossil animals. The case figured is that of a lower molar of a three-toed horse, *Merychippus campestris*, from the Miocene of Nebraska. The lesion does not differ essentially from similar lesions today. Joseph Leidy in 1886 called attention to caries in the mastodon. The supposed caries appears as an irregular excavation immediately above the crown of the tooth, about one-half inch in depth, the surface of which appeared to be irregularly eroded. Caries has been further mentioned in the fishes from the Permian by Renault, who ascribes the result to several types of bacteria. Dollo has mentioned an example of caries in one of the lower teeth of a Mosasaur, one of the large Cretaceous reptiles.

Pathological evidences among extinct vertebrates, older than 3,000,000 years. The animals which preceded the mammals were as liable to disease as were the mammals themselves, and it seems possible that the mammals may

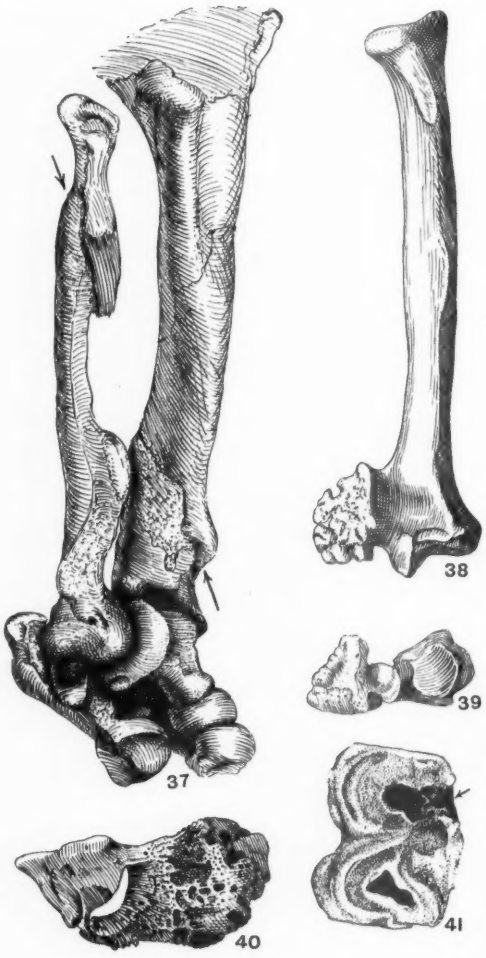


Fig. 37. Leg bones and tarsus of *Aeleurocyon*, a dog-like animal from the Miocene of Nebraska, showing, at the arrows, an oblique fracture of the fibula, and tibia, with resulting callus and hyperostoses.

Fig. 38. Right radius of *Daphaenus felinus*, a large dog from the Oligocene of Nebraska, 2,500,000 years old, showing on the lower end a large exostosis, which is matched by a duplicate lesion of the other radius. (After Hatcher.)

Fig. 39. End view of the same bone as is shown in Figure 38.

Fig. 40. A phalange of an extinct mammal, known as *Merycochoerus rusticus*, a pig-like ruminant from the Oligocene of Nebraska, 2,500,000 years old, showing extensive carious roughening. (After Leidy.)

Fig. 41. Lower molar of a three-toed horse, *Merychippus campestris*, from the lower Miocene of Nebraska, 2,000,000 years old, showing at the arrow, dental caries.

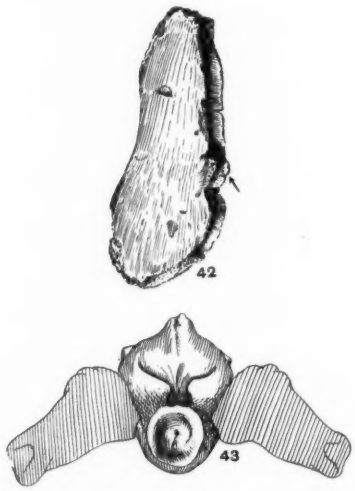


Fig. 42. A diseased bone of an embryonic marine reptile, a plesiosaur, from the Cretaceous of Kansas, 15,000,000 years old. The diseased lesion is seen at the arrow.

Fig. 43. A sacral vertebra of another plesiosaur, *Proneusticosaurus*, showing a thickening or hypertrophy of the bone resembling the results occasionally seen in gigantism. (After Volz.)

have acquired some of their diseases from the preceding reptiles. A few examples of disease and injury among the dinosaurs may be shown here as continuing the evidence of disease back into geological time. The bones of these gigantic reptiles, the dinosaurs, were for the most part solid and fractures (Fig. 45) of these bones are always simple transverse breaks. Exostoses, necroses, tumors, and other interesting lesions are to be seen among the Cretaceous reptiles and among the preceding forms as far back as the Carboniferous when the first known evidences of disease are met with. The early and greater part of the life history of the earth was free from disease, or evidences of its presence have not yet been seen.

Microscopic study of ancient lesions. It is readily possible, by petrographic methods, to study the bone lesions microscopically as can be seen by referring to Fig. 44, which is a drawing, 700 diameters, of a lesion due to osteoperiostitis on the humerus of an ancient reptile, 16,000,000 years old. Often in studying these ancient bones microscopically one sees bacteria included within the lesions.

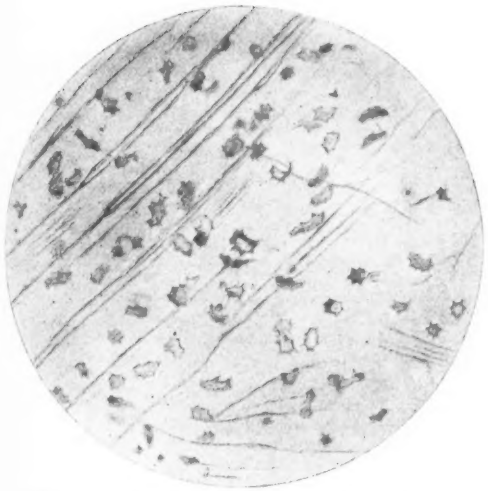


Fig. 44. A drawing of a microscopic section of a lesion of osteoperiostitis on the humerus of an ancient reptile, 15,000,000 years old, showing the nature of the perforating fibers of Sharpey and the osseous lacunæ, with their short canaliculi. The fibers of Sharpey run in bundles and this high power drawing shows the nature of one of the bundles, largely confined to the left of the figure.

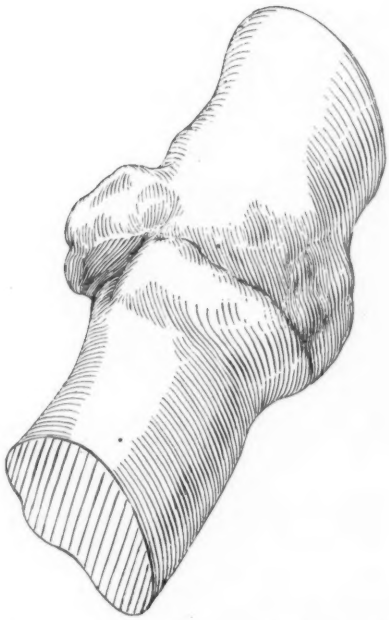


Fig. 45. A simple fracture in the rib of a gigantic land reptile, a dinosaur, known as *Apatosaurus*, the skeleton of which is mounted in the Field Museum of Chicago. These huge reptiles attained a weight of nearly forty tons, a length of nearly seventy feet and a height of fifteen feet. The rib measures seven inches across and has a length along the curve of eight feet. It must have taken a terrific blow from one of his fellow dinosaurs to have broken this rib, which healed with the formation of considerable callus.

These have been especially well studied by Renault, who has been able to demonstrate natural cultures of bacteria preserved in silicon.

Origin and nature of ancient diseases. So far as present evidences may be read diseased conditions are very ancient and have attacked animals and plants for many millions of years. The nature of disease among ancient animals is not different from the pathological processes which take place in man at the present day. Disease doubtless started when races of animals began to go toward extinction, but much work needs yet to be done before we can read the history of disease as it is seen in the skeletal remains of animals which lived many milleniums ago.

SUMMARY

The remains of fossil man and extinct animals show evidences of diseases which are comparable to recent lesions. Indications of disease are rare compared with the abundance of remains of ancient races. This may indicate that disease has not been so prevalent in the past as at present, although it must be remembered that the evidence is all skeletal. Some of the lesions seen on fossil and sub-fossil remains are: osteoma, hæmangioma, fractures, callus, osteoperiostitis, necrosis, caries, alveolar pyorrhœa, hyperostoses, osteomalacia, spondylitis deformans. These and many other interesting lesions show us that disease is no new thing but has been manifest in a diversity of forms for many millions of years.

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MECHANICAL TREATMENT OF PERIPHERAL NERVE INJURIES[1]

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THE problem of peripheral nerve injuries does not begin with surgical interference nor does it end with operative procedure. The treatment of these cases requires an understanding, not only of peripheral nerve surgery, but also of the mechanical and postural management of the resultant paralysis. An intimate knowledge of the attitude of these patients toward their injury is also essential. Due to their frequent hopeless outlook, there is probably no organic lesion in which the personal element of the surgeon may more profitably enter. Their convalescence is not a matter of weeks, but months and years. They constantly see their comrades, though apparently more seriously wounded, leave the hospital while they are still retained. Their wounds, though outwardly healed, show to them no real appreciable evidence of improvement. Complications often develop; they frequently may suffer exquisite pain. In certain cases traumatic ulcers occur and cutaneous regressive changes are constantly apparent. In no class of organic injuries is there more imperative need for the will to recover and in none is it more often wanting. Constant effort, especially in the early stages of regeneration, should be devoted to the use and re-education of the paralyzed muscles. Instead many patients by this time have become resigned to their deformity and have given up the will to regain control of the part. Frequently there is superimposed on an underlying organic lesion an element of functional disorder, in itself many times more trying to handle than the nerve injury.

However skillfully surgical interference may remove all obstacles to the downgrowth of the neuraxes and facilitate their further growth, the return of motor function may not occur unless there has been comprehensive preoperative and postoperative treatment. The rôle of such treatment is to prepare the paralyzed parts, so that after nerve regeneration and neurotization there may not occur peripheral obstacles to return of function. Such obstacles may reside within the paralyzed muscles, which have lost their native power of contractility and have undergone marked regressive changes, which have been hastened and rendered more complete by force of gravity, overstretching, and poor nutrition. Or obstacles may occur in the antagonist muscles, which have been allowed to undergo adaptive shortening with final permanent contractures,

[1] On special detail in experimental nerve surgery under Dr. Huber, Director of the Department of Anatomy, University of Michigan.

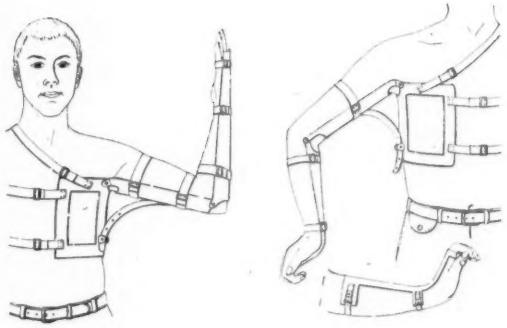


Fig. 1 (at left). Adjustable abduction splint with adjustable forearm piece for paralysis of the fifth and sixth cervical nerves. The arm is held in abduction and *external rotation* with the hand in supination. By altering the pin and lever to the arm piece, the arm can be held in any desired angle of abduction. Forearm piece may also be adjusted by screw lock to various degrees of flexion. The splint is made of aluminum and lined with felt.

Fig. 2 (at right). Author's splint for total and partial paralysis of the musculospiral. *A* (above). Adjustable aluminum abduction splint with forearm piece to maintain the wrist in dorsi-flexion. Arm held in abduction with the wrist dorsi-flexed. *B* (below). Small dorsal skeleton splint (similar to Jones' splint only dorsally placed) to prevent wrist drop. Consists of a narrow dorsal piece and annular portion extending across the proximal phalanges of *all five* fingers. By being dorsally placed greater freedom is given to the palm. Note angle of elevation of the wrist.

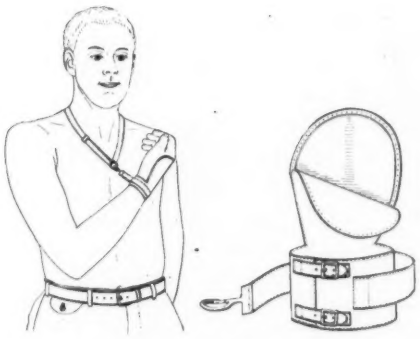


Fig. 3. Author's wrist strap for paralysis of the musculocutaneous. *A* (at left). Arm held in semi-flexion and drawn across to the opposite shoulder. Hand is held in supination. Metal dorsal extension piece supports the hand and prevents it from falling into dependent position. The small strap about the wrist is attached only to the volar surface on the *radial side* and passes *under* the wrist, thus assisting in maintaining supination. *B*. To illustrate wrist strap and metal extension. Leather is ripped and turned back showing metal piece which extends from wrist across dorsum of hand. Note line of attachment of small wrist strap and that it passes *under and behind* the wrist.

limiting materially the proper range of motion. The purpose then of suitable and adequate mechanical treatment is to attempt to maintain the nutrition of the part and prevent overstretching or contraction of the muscles paralyzed or contractures of their antagonists.

It has long been recognized that if a muscle is permitted to be overstretched, it may not regain its contractility even after neurotization and hence, though the nerve injury had been repaired, return of motor power might not take place or be greatly delayed. It has been shown many times in the treatment of anterior poliomyelitis that muscles which have been paralyzed and not treated posturally, in which overstretching had taken place, frequently show a return of function when the postural deformity has been corrected and the overstretching overcome. Neurotization though complete was unable to bring about a return of contractility. A paralyzed and overstretched muscle loses more permanently its contractility and undergoes more marked regressive changes than a paralyzed muscle in which overstretching has been prevented.

The first cardinal principle then of mechanical treatment of peripheral nerve injuries is to obtain relaxation and prevent overstretching of the paralyzed muscles.

There are two main types of apparatus: those which aim to prevent overstretching and correct faulty position and those which attempt to replace a part of the movement lost. The latter rarely are efficient in their correction of the total deformity; e.g., the spring appliances to prevent toe drop endeavor to replace the dorsi-flexion of the anterior group, ignoring the associated postural deformity, due also to paralysis of the peronei and the coincident disturbance in the mechanics of the foot and the faulty deviation of body weight. To these we will refer again. An appliance is to be preferred which tends to correct the total deformity and prevent overstretching, rather than replace movements lost. Each appliance should be made for each individual case. Only general types will be outlined here, which have proven of value. Modifications should be made when-

ever expedient. All splints should be altered and changed according to the stage of progress and repair of the paralysis.

The importance of mechanical treatment is clearly indicated by the report of Laquerrière and Peyré, who state that in fully 50 per cent of cases reporting for physiotherapy, deformity might have been avoided by proper splinting and by surgical interference not too long delayed.

The ideal apparatus should be light, simple, easily applied and removed, should immobilize no more than is necessary, should be cheap and inconspicuous. Furthermore, it must treat the total deformity — not merely one of the apparent faulty positions. The straps should, in so far as possible, not constrict the muscle bellies but rather fall upon the tendinous parts. Great caution must be observed to avoid pressure sores, particularly in cases of contractures and where there is scar tissue, since it must be remembered that there may be anæsthesia, not only of the superficial parts, but also of the deeper structures and warning by means of pain may not be given.

All splints when removed at night should be replaced by other apparatus more comfortable and approximately as efficient. Appliances should be worn constantly without ever once allowing the muscles to become overstretched. According to Colonel Sir Robert Jones one single indiscretion may retard all that has been gained by prolonged treatment.

Early mechanical treatment. The mechanical management of peripheral nerve injuries may be divided into the immediate and the late or subsequent treatment. The former include the first few weeks until the associated injuries have progressed far enough to permit of definite treatment directed toward the nerve lesion. The early management of these cases will depend very largely upon the concommitant and coincident injuries. However, given a case in which the nerve injuries alone predominate, i.e., without tendon or bony injury, the extremity should be placed, according to Stoffel, so that the severed nerve ends may be brought into close proximity and there held for a few weeks, during which time the nerve ends will become anchored and a more relaxed position may then be assumed.

This is in fact applying to nerve injuries principles long in usage for muscle and tendinous lesions, where immediate repair has been impossible. For nerve injuries it seems to be of questionable value, for after the immediate retraction of the nerve ends at the time of severance, shortening, as is the case in injuries to tendon and muscles, due to contraction of muscle bellies and pulling asunder of the tendon ends, does not take place. The severed nerve tends to assume immediately a definite position and to keep it, being held more or less firmly in place by the fascial layers which so intimately surround the nerve trunk. However, all things being equal, there can be no objection to using this procedure.

The position maintained will depend not only upon the nerve but also on the level of the lesion. In injuries to the median and musculospiral in the upper arm, the arm should be adducted and the forearm acutely flexed; in injuries of the ulnar, the arm is adducted and the forearm held extended; in injuries below the elbow to the median, the forearm is bent at a right angle and the hand placed in full supination and the same position for the musculospiral, except that the hand is held dorsi-flexed; in ulnar injuries at the same level the forearm is fully extended and the hand flexed in slight adduction. The sciatic is relaxed by flexion of the knee. Where there are other injuries, such as fracture, which might lead to more or less permanent deformities, it is needless to say that the primary indication is to treat them. For what avails it, if when the nerve repair has taken place, there is permanent disability due to mal-union, contractures, or other deformity. The coincident treatment of these will hardly fall within the scope of this paper.

Correction of deformity before operation. Prior to operative interference in nerve injuries all contractures must be overcome. Free mobility of all joints is a *sine qua non* before any operative procedure can be undertaken. Most obstructions to mobility are mechanical, hence, even though the nerve should repair its injury there would remain

definite block to the return of motion. Contractures and adhesions should be stretched gradually. Continuous and gradual stretching is better than daily passive movements. Daily movements when of sufficient force to increase mobility constantly tear the fibrous tissue which in turn sets up new fibroblastic reaction, and therefore should be avoided. Gradual overstretching gives less reaction and is more permanent in its effect. In some cases adhesions may be broken up under ether and then by constant stretching continuing the treatment. It must be remembered that in extensive paralysis the bones become brittle, consequently adhesions should be broken only by the experienced.

Neuritic contractures are extremely difficult to handle. Increasing the immobility only serves many times to accentuate the deformity; contractures recurring within a few days after removal of the appliances. In such instances daily movements and baths with electricity must be combined with immobilization. The most satisfactory treatment is prevention before the contractures have become marked. In the early stages the muscle groups show an increased hypertonia with beginning tenderness of the muscle bellies, and gradual postural deformity, which can readily be overcome by passive movements. In the later stages the tenderness becomes very marked and the muscles extremely sensitive to mechanical stimuli. On slightest efforts the muscles are held in extreme contraction, almost a tetanic spasm. They finally become rigid and cannot be passively corrected. Mechanical treatment in such cases must be developed in each individual instance. Here the effort is not to prevent definite contractures but rather so to overstretch the muscles that for the time being they lose all power of contraction. Positive splinting combined with contrast and electrical baths will usually be most serviceable.

Mechanical treatment of the more distinct types of peripheral nerve injuries will be treated separately except in those instances in which the associated paralysis may be similarly handled. Combined and multiple peripheral lesions are variable and will require in each case modified types of apparatus.

Brachial plexus; injuries to the fifth and sixth cervical nerves. Injuries to the brachial plexus are extremely variable in extent, depending upon the level of the wound. In general it may be said that those above the clavicle are injuries to the roots and primary cords, either single or multiple, whereas, those below the level of the clavicle and in the axilla include the secondary cords and nerve trunks and are frequently accompanied by trauma to the larger blood-vessels. Of all peripheral nerve lesions, perhaps none require more efficient and continuous mechanical treatment. The deformity is extensive and the possibility of return of function poor. Particularly is this true when there are marked arterial injuries superimposed upon an already extensive paralysis and introducing an element of ischæmic paralysis.

Of the supraclavicular injuries there are two main types: the Erb-Duchenne, or upper root group, involving the fifth and sixth cervical roots; the Aran-Duchenne, or lower root group, implicating the seventh and first nerves. In the former the resulting paralysis is extensive, including the muscles of the shoulder girdle and even those upon the back, as well as muscles of the arm and forearm. In the Aran-Duchenne the paralysis is essentially of the ulnar side of the forearm and the muscles of the entire hand.

The muscles involved in paralysis of the fifth and sixth cervical nerves are those of the shoulder girdle: supraspinatus, infraspinatus, subscapularis, teres major, deltoid. If the lesion is close to the exit of the roots from the vertebral canal in addition, the major portion of the serratus magnus, rhomboidei, and levator anguli scapulæ may be included.

Those of the arm are the biceps, brachioradialis, brachialis anticus. Those of the forearm are the pronator radii teres, flexor carpi radialis, palmaris longus, supinator brevis. These may be incompletely paralyzed. In those injuries, in which the muscles of the back are involved, the deformity is extensive, because the compensatory movements of the scapula, so important in deltoid paralysis, are materially lessened, if not altogether lost. It will be recalled that by development of the

serratus magnus and trapezius the movements of the scapula may be made to compensate and take on, to a considerable degree, the movements of the shoulder girdle. Hence, in injuries involving the nerves to the serratus magnus, rhomboidei and levator anguli scapulæ, as well as the deltoid and supraspinatus, the range of movement left is almost nil. Furthermore, the action of the serratus magnus in fixing the scapula so that the deltoid may act is gone — a point which must be borne in mind, and the scapula manually supported when the deltoid is being re-educated in the early stages of recovery.

There is complete loss of flexion of the forearm on the arm due to the paralysis of the biceps, brachioradialis and brachialis anticus; in the forearm, in some instances, incomplete paralysis of the pronator radii teres, flexor carpi ulnaris and palmaris longus and supinator brevis. Thus the deformity is extensive, including all the important components of the upper extremity. The arm lies adducted with marked inward rotation, due both to the action of the latissimus dorsi, pectoralis major, and coracobrachialis. The humerus is soon subluxated and in neglected cases completely dislocated. The coracoid process is prominent. The forearm cannot be flexed and is held in semi-pronation. The palm of the hand faces backward, due to total inward rotation of the entire extremity. Left to themselves without efficient mechanical appliances there is permanent, irreparable deformity. The deltoid suffers most, being stretched due to adduction and the unopposed dependent weight of the extremity. This is especially seen in infantile paralysis when not properly splinted, in which the permanent loss of power in the deltoid is most marked and the return of function slower, so that attempts at retraining are discouraging.

In the deformity about the shoulder there are two distinct postures which must be attained: First, abduction to relax the deltoid and the supraspinatus; second, and the one most overlooked, *external rotation*. Quite often the only apparatus used is an axillary pad and a sling, or a simple abduction splint. Such measures are inadequate.

The arm must be held in abduction, preferably at an angle of about sixty degrees with the axis of the humerus in the mid-coronal plane, so as to relax the clavicular and scapular portions of the deltoid. If brought forward beyond the coronal plane neither the deltoid nor the supraspinatus are placed in the most favorable position. Complete abduction to ninety degrees is extremely awkward and in some cases in which there may result permanent deformity it is a position of least service. In addition the arm is over-corrected in external rotation and the forearm flexed upon the arm, a little beyond a hundred degrees and held in slight supination so that the hand looks toward the face.

The author's splint here shown has been found satisfactory. There are many other similar appliances; however the advantage of this apparatus is that the angle of both abduction and flexion may be altered at will. It is made of an aluminum frame lined with felt, consisting of a chest piece, of an adjustable arm and forearm piece. The arm piece is hinged and can be altered and held in various angles of flexion. There are three chest straps of canvas, two around the chest, the third around the opposite shoulder. This last strap may be placed around the same shoulder but it is better to avoid any constriction or pressure on paralyzed muscles. The arm and forearm straps are placed, as far as possible, over the tendinous parts rather than the muscle bellies. By slight torsion of the forearm piece the degree of supination may be varied. No matter what type of splint is used, the arm must be in abduction, external rotation and the hand in supination. There are many other splints but this one has proven very serviceable and perhaps has much to commend it.

In injuries involving the last cervical and the first thoracic nerves, the paralysis is limited in its manifestation to the ulnar side of the forearm and the muscles of the hand, with the exception of the adductor pollicis, and the opponens pollicis, which receive fibers from the fifth and sixth cervical nerves and hence, are not included. The two radial lumbricales escape, yet I have never seen in these cases at examination any evidence of their action. In the forearm the flexor carpi

ulnaris, flexor profundus and sublimus, as well as the flexor longus pollicis, are paralyzed.

The deformity is slight radial abduction on flexion, due to the flexor carpi radialis, with loss of all the flexors of the fingers and thumb. The hand is the typical flat hand seen in combined median and ulnar injuries. There may be marked tendency to contracture, marked hypotonia and in neglected cases, subluxations of the interphalangeal joints.

A straight splint in line with the forearm, with individual grooves for each finger, with the fingers in slight abduction, offers the most satisfactory mechanical treatment. This type of splint is best made in light material such as papier maché and copied from a mold made for each individual case. The straps should be so placed, in so far as is possible, so that slight extensor movements of the fingers may be carried on; the flexion part being accomplished by gravity. The fingers are raised and allowed to fall to the level of the splint.

Injuries to the seventh cervical root and musculospiral nerve. Injuries to the middle primary trunk, the seventh cervical root, as well as to the middle secondary trunk, result in essentially *total* paralysis of the musculospiral, in which, however, the action of the brachioradialis is retained (supplied by the fifth and sixth through the musculospiral), thus differentiating the paralysis from the more peripheral type. The deltoid, triceps and extensors of the wrist, fingers and thumb are paralyzed.

The essential deformity is loss of abduction, inability to extend the forearm, the wrist, and all the fingers. The arm hangs in abduction, usually with very little inward rotation, the forearm slightly flexed and complete wrist drop. Mechanical treatment should endeavor to relax the deltoid and overcome the result of gravity upon the extensors. The arm should be held in abduction with the forearm slightly flexed and the wrist dorsiflexed to about fifty degrees. The author's splint shown here for this paralysis is similar to the appliance for paralysis of the fifth and sixth roots. Due to the anatomical arrangement of the triceps this muscle is not apt to be overstretched. However, on account of gravity and adaptive shortening of the

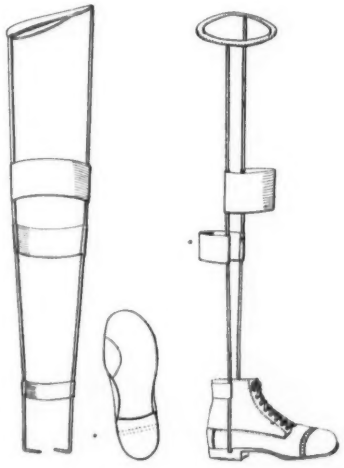


Fig. 4. Thomas caliper for paralysis of anterior crural. Note angle at which caliper should be inserted into shoe so as to obtain slight inversion of foot. The shoe is elevated on inner border so as to deviate body weight and lessen the strain on knee-joint. A spring lock may be used to permit flexion on sitting.

Fig. 5 (at right). Thomas caliper for total paralysis of the sciatic. Fixed iron and sole plate to maintain the foot slightly dorsi-flexed and prevent toe drop.

flexors, the extensors of the fingers and wrist undergo marked regressive changes, unless properly splinted.

In paralysis of the musculospiral below the circumflex there is complete paralysis of the brachioradialis and usually partial paralysis of the triceps. The branches to the long head of the triceps come off fairly high, hence, at least one head is apt to escape, but the extensors of the wrist and all fingers are thrown out, with subsequent wrist drop. Untreated, the postural deformity gradually increases, the wrist falls almost to a right angle due to gravity and extreme atony, combined with the unopposed action of the flexors. Subluxation about the carpus may occur and œdema is frequent.

Correction of the deformity consists in preventing wrist drop. Even after successful repair of the nerve, return of motor function is immeasurably delayed unless overstretching is prevented. To accomplish this there are numerous appliances to maintain the wrist and first phalanges in a dorsi-flexed position. There is no need to elevate the second and

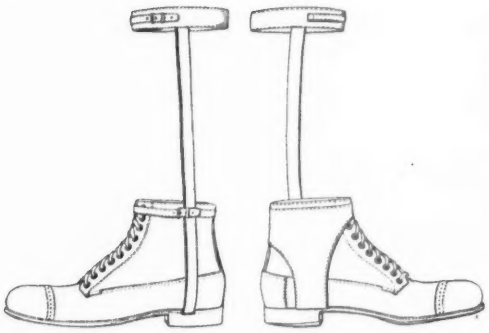


Fig. 6. Short caliper for paralysis of both internal and external popliteal. *A* (at left). Outside iron with metal sole plate (indicated by dotted lines) extending from heel to metatarsophalangeal joint. *B*. The same, with one-third inch elevation on sole and heel and inside strap to prevent valgus deformity and lend support to the ankle.

third phalanges, since extension is accomplished by the interossei acting upon the extensor tendons. To obtain the optimum relaxation, the wrist should be elevated to about fifty degrees. All splints should include the thumb, since the extensors to the thumb are also implicated.

Appliances which hold the wrist straight and in line with the forearm are not efficient and do not prevent overstretching. Most of them seek to replace the action of the extensor tendons by using rubber tubes or flexible metal bars. These are very convenient and so far as motion is concerned satisfactory, in that they permit the patient to make excellent use of his hand. However, the wrist must first be elevated to at least fifty degrees and the range of motion supplied from that angle. Splints which are dorsally placed, by leaving the palm unobstructed, are more satisfactory and permit of greater use of the hand—a by no means negligible consideration.

Musculocutaneous. Injuries to the musculocutaneous destroy the nerve supply to the biceps, brachialis anticus and coraco-brachialis. Normally there is a slight supply to the brachialis anticus from the musculospiral but rarely sufficient to permit of a functional contraction. The first two mentioned are the principal flexors of the forearm, though this movement is not completely lost due to the compensatory action of the brachioradialis, which may produce forcible flexion of the forearm upon the arm. However, the forearm usually can *not* be flexed if the arm is made to hang by the side in full extension and in supination. Generally when seated for examination the patient will attempt to place his hand upon his thigh and thus with the forearm slightly bent, the brachioradialis will be able to flex with considerable force. This action may be rendered more difficult and, in not a few, impossible if the hand is placed in full supination. When the hand is in full pronation the brachioradialis may, in its contraction to produce supination, gain slight leverage and thus obtain further contraction in the direction of flexion. Occasionally in testing with the arm hanging the patient will begin to swing the extremity back and forth and on an upstroke the brachioradialis may find sufficient leverage to complete flexion.

There is very little mechanically indicated for this paralysis since there is very little overstretching. Stimulation of the triceps produces greater extension due to lack of influence, particularly of the brachialis anticus, in limiting this movement. By reason of the bony shape of the joint there is little deformity — the olecranon process meeting bony resistance against the olecranon fossa. The action of the brachioradialis should be developed by frequent and graded exercises, thus maintaining a free range of motion. To prevent overstretching in attempts to carry weights, etc., and to limit other unguarded movements, the arm is held in flexion with the hand in supination and the arm drawn forward in the direction of the opposite shoulder. A broad leather cuff, with either a collar piece, or a pin and snap to fasten to the garment, will suffice to maintain this position satisfactorily. The wrist strap includes a metal extension running forward across the dorsum of the hand and wrist, serving as a support for the hand and preventing it from falling into a dependent position. Unless this support is used the patient will find the attitude uncomfortable and in order to correct it will attempt to pronate the hand on to the chest and make the chest serve as a support. A dorsal extension piece makes the fully supinated position both easier to maintain

and more comfortable. The small support strap which is attached only on the volar surface of the radius, passes over the radius on to the dorsum of the hand and thus tends to hold the hand in the supinated position.

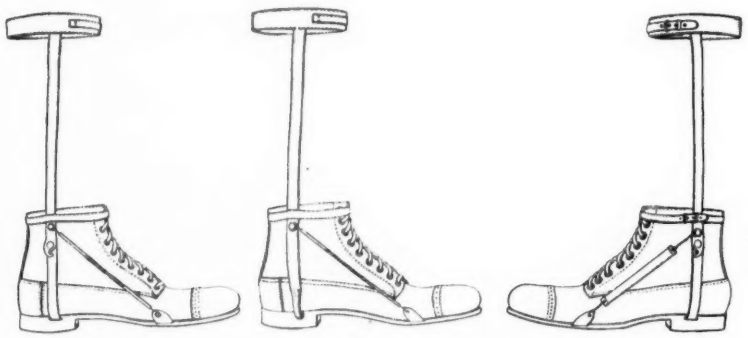
Ulnar nerve. The clinical manifestions of ulnar nerve injuries are extremely variable due to the large number of muscles supplied, to their rather antagonistic action and to the variability of supply. Furthermore, the clinical type varies materially according to the level of the lesion, i.e., whether above or below the supply of the profundus.

In complete paralysis the hand becomes soft and flexible, because of loss of support to the arches, by atrophy of all muscles of the hand and relaxation of the ligaments. Subluxation of the metacarpophalangeal joints occurs as a result of the unopposed action of the extensor tendons of these joints. The fifth, fourth and third fingers, to a less extent, are held in semi-flexion; occasionally, when the ulnar sends twigs to all the profundus heads, the third and second fingers are flexed due to the unopposed action of the flexor sublimus and the loss of extension performed by the interossei. When the profundus is not included in the paralysis the deformity becomes more marked since the distal phalanx is acutely bent.

Usually in a complete lesion there is very little contracture. However, in nearly every case I have seen there have been fibrous adhesions and very definite limitation to the joints of the middle and proximal phalanges, especially of the fifth and fourth fingers, so that complete extension becomes impossible. In the neuritic type there are very marked adhesions and dense scar tissue, leading many times to irreparable deformity, in spite of treatment. Great care must be taken in the mechanical treatment of both types. Immobilization may prevent contractures and in the neuritic type produce them. Yet without immobilization contractures are certain to appear. Immobilization alone or mobilization alone does not prevent contractures. ***Efficient immobilization must be combined with efficient mobilization.*** All movements should be regularly performed and the periods of repose guarded by apparatus.

Fig. 7. Caliper for paralysis of external popliteal. *A* (at left). Inside iron with fixed sole plate and stop lock to prevent toe drop and yet permit flexion of the ankle. Foot held slightly dorsi-flexed to give greater facility in walking. *B*. The same, outside elevation of sole and heel and outside ankle strap to prevent varus deformity.

In the simpler cases straight splints suffice, whereas in the neuritic the principal contractures must be rigorously overcome by overcorrection. For the complete lesion a simple straight palmar splint with individual gutters for each finger, with the fingers in slight adduction, will offer the best mechanical treatment. In the milder cases a two finger splint for the fifth and fourth fingers, extending across the palm to the thenar eminence, thence across the wrist and forearm will be sufficient. In the contractures of neuritic origin the deformities are most varied. Usually the fifth and fourth fingers and partially the third are rigid in flexion and the deformity is increased by fibrosis of the palmar fascia, very like the changes in the fascia in Dupuytren's contracture. Such deformities become fixed and irreparable even after nerve repair may have taken place. The principle of splinting in these cases must be to overcorrect the tendency to deformity during the period of repose, and immobilization should always be *combined* in these cases with active and passive movements. A straight splint including the hand, dorsi-flexed to an angle of forty to fifty degrees will be found serviceable. There should be separate grooves for each finger and each finger should be held in slight abduction, so as to prevent overaction of the interossei. From time to time the angle of dorsi-flexion should



A. *B.* *C.*

Fig. 8. Author's spring device to replace extension in foot drop. *A*. An inside iron with fixed sole plate and stop lock is fitted with metal spring or rubber band extending from above center of astragalo-tibio-fibular articulation to beyond metatarsophalangeal joint. The dorsal pull of spring replaces the action of the extensors so that walking is done with greater facility and ease. The inside iron and ankle strap and elevation of shoe correct the associated deformities. *B*. The same without stop lock or sole plate. Inside iron fits into socket in the heel. Is fitted with spring device similar to that in *A*. *C*. Outside iron fitted with rubber device to replace extension in paralysis of both internal and external popliteal. Stop lock and sole plate prevents plantar flexion.

be increased. Passive movements and active movements must be repeatedly done and the patient made to try to use each muscle group during the period of exercise.

Median nerve. By severance of the median nerve there is paralysis of the flexors of the wrist, second and third fingers and thumb, loss of both pronators, though pronation may still persist in some cases on account of the action of the brachioradialis, and also paralysis of the abductor and opponens of the thumb.

The forearm lies in supination. Occasionally the brachioradialis may perform both supination and pronation depending on its point of insertion in the base of the styloid process of the radius. For the same reason according to whether its insertion lies more anterior or posterior to the median line it may be either a supinator alone or a pronator. Flexion at the wrist is still accomplished by the flexor carpi ulnaris. In the effort to flex there is marked adduction, because the synergic action of the flexor carpi radialis is wanting. There may also be slight flexion of the thumb due to the deep head of the flexor brevis pollicis, supplied by the ulnar. Flexion of the proximal phalanges may still take place by means of the interossei. Frequently the ulnar also supplies the slip to the third finger, hence, flexion of this finger may be present.

Contractures are rather rare. When they do occur there is partial flexion of the thumb and second and third fingers, with slight tendency to contraction of the palmar fascia. The distal phalangeal joints of the second and third fingers tend to become fixed in slight hyperextension.

A straight splint with slight flexion for the distal phalanx made after a plaster model, with separate grooves for each finger, will offer sufficient mechanical support. The splint need not extend in the palm any further than the hypothenar eminence and thence across the wrist on to the forearm. This position does not allow complete relaxation or complete overcorrection. The overcorrected position of the flexors occurs only with the wrist dorsi-flexed to about seventy degrees, since with flexor contraction there is synergistic extension of the wrist; e.g. in all attempts to grasp there is coincident extension of the wrist. Hence, the straight splint by assuming about the mid-position offers sufficient relaxation and prevents the more usual deformities in the neuritic types. These are rarely severe. In severe types the fully extended position may then be used.

In combined median and ulnar injuries both pronators, all flexors of the wrist, fingers and thumb as well as the intrinsic muscles of the hand are paralyzed. The hand is flat and there is marked relaxation of all articulations, frequently with subluxations of the metacarpal phalangeal joints. These are many times held in extreme dorsi-flexion by the action of the unopposed extensors. When contractures occur the usual deformity is acute flexion of the distal phalanges of the last four fingers and flexion of the thumb. The type of splint to be used was referred to in paralysis of the lower brachial plexus roots.

The patient may be able to flex the fingers, with the hand in pronation by quick extension of the wrist followed by sudden relaxation. A purely mechanical recoil occurs with slight flexion of the fingers. Some patients may accomplish this with the hand in supination. A few develop also flexion of the wrist by associated action of the extensors, which may lead, if a careful examination is not made, to an erroneous mechanical conception of the muscles paralyzed.

Anterior crural. Severance of the anterior crural is most uncommon and is usually associated with injury to the pelvis and great vessels. There is paralysis of the quadriceps extensors, sartorius and pectineus, with inability to extend the leg upon the thigh or to stand on the leg except when the knee is held in extreme extension. Unless carefully guarded the knee becomes a true trigger joint, suddenly giving away and letting the patient down. In walking the body is bent forward, the hand resting on the anterior surface of the thigh or, due to the action of the tensor fascia lata, the leg is locked in hypertension and a swinging gait is assumed.

Contractures are uncommon; however, in older cases genu-recurvatum is very prone to occur due to constant fixation of the knee in hyperextension. In neglected cases posterior subluxations of the tibia upon the femur may develop.

Mechanical support should offer stability to the knee and prevent hyperextension. This can readily be accomplished by the Thomas walking caliper, fitted with either a stop or spring lock, permitting flexion of not more than thirty-five degrees. The spring lock gives considerable comfort since in sitting it permits the knee to be slightly flexed and by limiting the degree of flexion overstretching of the extensors will be avoided. A broad strap placed behind the knee will prevent hyperextension and the occurrence of genu recurvatum.

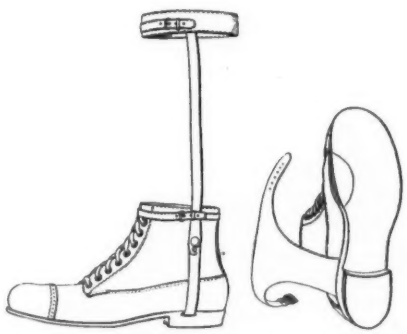


Fig. 9. Caliper for paralysis of internal popliteal. *A* (at left). Outside fixed iron and sole plate with reversed stop lock thus permitting dorsi-flexion and preventing calcaneus deformity. *B*. Shoe to illustrate shape of ankle strap and proper site for elevation on sole and heel.

With the support of the quadriceps gone, strain on the knee-joint is very apt to occur and should be guarded against. By alternating the relative position of the external and internal bars of the caliper as they fit into the heel, the foot may be thrown into slight eversion or inversion. The position of inversion throws less strain upon the knee-joint and the internal lateral ligament and is the position to be preferred in paralysis of the anterior crural nerve.

Sciatic nerve injuries. Total paralysis of the sciatic is extremely rare. Of sciatic injuries the external popliteal portion is most frequently involved. This peculiar vulnerability of the external popliteal has been the observation of surgeons in the Russo-Japanese war, the Balkan wars, and in the present war. The susceptibility is not only peripheral but central as well, being frequent in neuritis of toxic origin, such as alcohol, diphtheria, etc. In complete severance high up even at the level of the gluteal fold total sciatic paralysis does not occur, due to the fact that the muscular bundles to the long head of the

biceps and semi-tendinosus come off from the nerve as separate bundles at the level of the tuber ischii. Hence, these two muscles are rarely included in paralysis of the sciatic. The semi-tendinosus escapes more often than the long head of the biceps. It is capable of performing to a remarkable degree the function of all the other ham-strings as well as the flexion action of the leg on the thigh of the gastrocnemius. Such cases when fitted with suitable appliances show relatively little impairment of function. In fact one case of combined sciatic and anterior crural paralysis, in which the semi-tendinosus was saved, was able to walk, when fitted with suitable mechanical support, without much inconvenience, due to the compensatory development of the flexors and extensors of the thigh on the trunk.

In total sciatic paralysis all muscles below the knee are thrown out. The foot hangs flaccid, dangling as a dependent member. Due to the gravity and the total atonia of all muscles there is complete foot drop. There is also either varus or valgus deformity, together with acute flat-foot. This latter complication is often overlooked. On account of the anæsthesia there are no painful symptoms. Nevertheless the condition requires careful consideration in the plan of treatment.

The aim of proper mechanical correction is to give to the lower leg and foot stability, to correct postural deformity, to overcome faulty deviation of the body weight and to lend support to the relaxed arches of the foot. Unless all these factors are taken into consideration, the mechanical treatment will be inefficient and only partially of value.

Probably one of the most satisfactory appliances is a modified Thomas caliper, permitting flexion at the knee of forty-five degrees. This apparatus is light, comfortable and extremely serviceable. There are many splints, heavier and more cumbersome but not more efficient. In place of a stop lock a spring lock may be used. The patient walking stiff-legged and upon sitting is then able to release the lock and bend the knee. The caliper is fixed to a sole plate which extends from the heel to the metatarsal phalangeal joint, thus preventing toe-drop and calcaneous deformity. The upright is so fixed to the sole plate that it maintains the foot slightly dorsiflexed. A re-enforcement should be sewed on the inside of the shoe and the sole and the heel raised a third of an inch on the inner border to prevent valgus deformity and offer additional support to the weakened arches of the foot by deviating body weight. In total sciatic paralysis lower down, involving both internal and external popliteal branches, a splint, similar to the one in the diagram will be found extremely serviceable. An outside fixed iron with stop lock to prevent valgus deformity, plantar flexion, together with a spring arrangement to overcome toe-drop and assist in the elevation of the foot, makes a very light and efficient appliance. Walking up and down stairs is particularly rendered easier if the foot is held in this position.

It is extremely discouraging when motor power does return to have imposed upon an already existing deformity an additional postural deformity which might have been anticipated and corrected.

External popliteal. The anterior and lateral muscle groups of the leg are paralyzed in injuries to the external popliteal. There is complete toe drop and a tendency to varus deformity and in neglected cases equino-varus. Dorsal elevation of the os calcis is marked, due to the unopposed action of the muscles of the calf — they being normally about five times more powerful than the extensor group. Subluxations may be present in untreated cases. Flat foot occurs due to the loss of support by the peronei and the extensor groups to the arches, the former supporting both arches and the latter the inner. The gait is very awkward due to increased flexion at the knee in order to clear the toes from the floor. It is particularly noticeable in attempting to walk up hill or up stairs.

In treating this paralysis it is obvious that more should be done than simply to correct the toe drop. A fixed inside iron furnished with a stop lock to prevent plantar flexion will correct toe drop and also the tendency to varus deformity. An outside leather support should be sewed to the shoe to give support to the ankle. The shoe should be elevated on the

outer border both on the sole and on the heel, and thereby deviate the body weight on to the inside of the foot and thus tend to correct the varus position. Flat-foot should be supported by an inside plate, similar to the one described under internal popliteal. The patient should be cautioned not to walk at all, not even to the bath-room, without wearing a proper shoe. The body weight must be properly supported at all times. Most appliances used in this paralysis attempt to correct but one of the deformities, namely the toe drop, and ignore the other equally important deformities. The spring shoulder strap of M. M. Marie and Meige corrects nothing more than the toe drop and does not assist in the correction of the associated deformities. The same may be said of the metal spring devices of M. Léri, which passes up the front of the shoe. Therefore, these appliances seem to be inefficient and should not be used. The author's spring appliance, here illustrated, not only corrects mechanically the associated deformities but also tends to replace the action of the extensors. An inside iron with a stop lock may be used, with the stop lock so placed as to prevent plantar flexion and the fixed iron to hold the foot slightly dorsi-flexed. Either a metal spring or rubber band is attached to the shoe at or just beyond the metatarsophalangeal joint and on to the upright inside iron above the level of the center of the astragalo-tibio-fibular articulation, thus giving to the spring or rubber band an adequate anteroposterior pull. Any slight tendency toward inversion in the pull is prevented by means of the fixed iron, outside strap, and elevation of the shoe. About as useful is an inside iron without a stop lock, the iron being rounded at the end and made so as to fit into a socket in the heel of the shoe, the rubber band or spring preventing foot drop. However, of the two appliances, the former with the stop lock is to be preferred.

Internal popliteal. In injuries of the internal popliteal there is paralysis of all the muscles of the calf and sole of the foot with loss of flexion of the toes, abduction and adduction as well as plantar flexion of the foot. The walk is unsteady, the step is heavy and inelastic, the weight falling entirely upon the heel. Due to the unopposed action of the dorsal flexors the posterior surface of the os calcis tends to look down in place of backward. The arch is slightly more concave, depending upon the activity of the tibialis anticus and the extensor group, etc. There is usually valgus deformity due to the unopposed action of the peronei and also flat-foot with particular loss of the inner arch, due to paralysis of the tibialis posticus and the small muscles of the sole. Proper mechanical support should attempt to prevent dorsi-flexion, calcaneous deformity and the tendency to valgus posture. In addition, support must be given to the plantar arches. An outside iron with stop lock to prevent dorsi-flexion beyond a little more than a right angle will correct dorsi-flexion and calcaneous deformity. A slight bend to the side bar together with an inside leather support sewed to the shoe, as well as raising the inner border of the sole and heel will both deviate body weight to the mechanically stronger outer arch and correct the tendency to valgus. Inside the shoe an arch plate should be worn to strengthen and offer support to the arches. At night there should be worn a right angle splint, similar to the usual one used for club-foot.

Flat-foot. In all paralysis of the sciatic, the internal popliteal and external popliteal, there is a weakening of the arches of the foot and in most instances complete flat-foot. Perhaps the inside metal arch brace could not be more clearly indicated than in this class of flat-foot and yet in very few are they employed because as long as the paralysis and loss of sensation persist there are practically no painful indications of the condition. Most appliances seek merely to overcome the drop foot and ignore the remaining deformities which are of almost equal importance. A plaster cast or a molded imprint from dental wax should be taken and a steel plate made. Great care must be used since, if not properly fitted, pressure sores may develop. However, with slight precaution these can be avoided.

The patient should be instructed not to get up and about without the proper shoe and brace. One single indiscretion of this sort

may undo months of careful splinting and mechanical treatment.

The electricity, massage and baths. No treatment of peripheral nerve injuries would be complete unless it includes electricity, massage, and baths. The galvanic current is most serviceable and should be employed to make each group of paralyzed muscles contract daily. The faradic current is especially helpful in the early cases of regeneration when slight muscular contraction has returned. All forms of massage should be tried according to the type of case. Contrast baths are very excellent, particularly where there is much scar tissue. These forms of treatment all tend to improve the nutrition, prevent degenerative changes in the tissues, maintain muscle contractility and serve to lessen pain. Therefore, they are of extreme importance and should be given with regularity in conjunction with passive motion and muscle training.

Re-education and passive motion. During the entire period of paralysis careful and guarded passive motion should be done, putting each muscle group through its normal, though somewhat restricted range, so as to avoid overstretching. The movements at first should always be under the guidance of the surgeon. Later on after the patient has been shown the proper motions and the range through which he may exercise his muscles, he may be permitted to do the exercises alone. A practical point for the military surgeon handling numbers of like injuries is to arrange them into groups, according to injury and progress of the case and place them in charge of one of the wounded, either a sergeant or a corporal and have the group go through their exercises as a class. Definite counts should be used for each movement, as in setting up exercises. A definite time can be given and a set of exercises, gradually and properly graded for each group. If a case, which is visibly recovering, be placed in the group there will be considerable stimulation and encouragement to the others. There develops also a certain amount of rivalry and amusement which helps to make a monotonous task something of a diversion. Passive motion should be followed by massage and contrast bathing. In place of massage a rubber ball on the end of a stick and short rapid strokes delivered over the part by the patient may serve as well. This method of percussion massage is of much help. Thus a given group may be put through passive movements, massage, and contrast bathing under the guidance of the surgeon or masseur, etc.

Passive movements, such as flexion and extension exert a mechanical influence on the flow of blood and lymph and thereby help to improve the nutrition of the part. Passive movements, furthermore, insure the maintenance of the range of motion and prevent the formation of contractures. In the early stages of recovery there is great need for constant effort at re-education and muscle training of all the paralyzed muscles. This is especially true in nerve injuries, since it is rarely ever that the same funiculi are united at operation. Not only must the new axes form new end plates, perhaps in another muscle, but also new cell groups, in the anterior horns and higher centers, must compensate and rearrange their function in view of the new termination of their axes into new muscle groups.

Each muscle should be put through carefully selected exercises. At first the movements are done passively with the assistance of the surgeon and with the concentration of the patient's effort. A given movement is ordered by the surgeon and the patient, the surgeon assisting manually in the performance of the movement. All patients must be made to realize that they can succeed and must center every effort to that end. The assistance of the surgeon is gradually lessened as the regeneration progresses until the exercises are done against gravity and finally against resistance. All movements must be carefully guarded and care must be taken not to overdo muscles which are readily fatigued.

There is no more important factor in the ultimate recovery of many of these cases than their own attitude toward recovery. Many find that by wearing an appliance the disability is comparatively small and become content and resigned to some form of apparatus. It must be made constantly clear to them that such splints are purely temporary — an aid to cure and not a substitute. It is even advis-

able from time to time to change the type of splint. One of the ends of muscle training is to train the will and give definite encouragement. Successful treatment cannot be fully accomplished unless co-operation is gained. Hence, the patient should be taken into the confidence of the surgeon and the nature of his injury explained and wherein it differs from other injuries. A figure I often use is to explain that when a nerve is cut the nerve fibers must grow out from the center and the nerve requires time just as hair would take to grow so great a distance. Furthermore, treating the patients in groups, which are arranged according to the injury, tends to lend encouragement, particularly if a case which shows obvious improvement is placed among them.

Their time should be occupied and the morale must be sustained. This can be accomplished partly by employing all men in a curative work shop and giving them some form of work. In this way they are made to feel that they are accomplishing something and their minds are taken off of their own convalescence. Many types of employment can be given to a case of nerve injury, since they rarely have lost more than the use of one arm or leg and consequently are capable in many instances of doing full time duty. However, their work as well as other forms of treatment should at all times be under the constant guidance of the surgeon.

I wish to express my gratitude to Dr. Huber for his very keen interest and many valuable suggestions.

THE NEED AND VALUE OF BIOPATHOLOGICAL STANDARDIZATION[1]

By WILLIAM CARPENTER MacCARTY, M.D., Rochester, Minnesota

IN reviewing the present status of tissue pathology and its terminology in relation to clinical medicine, it seems that there has been a stationary period of about twenty years in which it has not rendered the greatest degree of efficiency.

It is possible that this period of quiet had its origin in the fact that tissue pathologists were dealing with end-results as seen at necropsy plus postmortem changes, and the imperfections of methods of fixation, all of which probably misrepresent the facts as they exist during life. The resultant conception made upon both pathologists and clinicians is somewhat comparable to that obtained in the study of systematic botany from dried, pressed specimens as compared with that derived from growing specimens in the field, or the conception of birds which is derived from stuffed skins. Such artificial and unnatural methods of study, however, certainly have their places in science and should not be condemned. Without them we should never have reached our present knowledge; but their usefulness as makeshifts is losing its value in the presence of newer methods and observations in pathology, clinical medicine, and general biology.

The second probable reason for the quiet of investigation in tissue pathology may be the fact that bacteriology, with its closely related sciences such as immunology and serology, has made its greatest advances during the last twenty-five years and has drawn men of vision, imagination, and initiative away from tissue pathology.

The pupils of such great teachers of tissue pathology as Virchow, Cohnheim, Ribbert, Rokitansky, Chiara, Orth, Borst, Welch, Councilman, Hektoen, Leconte, MacCallum, Adami, and others have become immunologists, bacteriologists, serologists, sanitarians, and cancer experts.

The field of tissue pathology has been practically deserted. Hospitals and teaching institutions are beginning to realize the great dearth of efficient men to carry on tissue investigations for clinical diagnostic purposes which they realize are absolutely necessary for efficient medical and surgical practice.

[1] Presented before the Southern Surgical Association, St. Augustine, Florida, December 18, 1917.

The following facts are examples of the necessity of expert microscopic tissue diagnosis to the clinician, surgeon, and pathologist:

I. FROM A CLINICAL STANDPOINT

Total number of cases registered in July, 1917.	4752
Total number of operations	1699
Total number of surgical specimens	1046
Total number of specimens removed for diagnosis	179
Total number of necessary microscopic diagnosis	208
Percentage of all cases operated upon	35
Percentage of all cases producing surgical specimens	22
Percentage of all cases producing specimens for diagnosis	3.5
Percentage of all cases which need microscopic diagnosis	4.3

II. FROM A SURGICAL STANDPOINT

Total number of cases registered in July, 1917.	4752
Total number of operations	1699
Total number of surgical specimens	1046
Total number of specimens removed for diagnosis	179
Total number of necessary microscopic diagnoses	208
Percentage of operations which yield specimens	61
Percentage of operations which need microscopical diagnosis	12

III. FROM A PATHOLOGICAL STANDPOINT

Total number of cases registered in July, 1917.	4752
Total number of operations	1699
Total number of surgical specimens	1046
Total number of necessary microscopic diagnoses	208
Total number of specimens removed for diagnosis	179
Total number of specimens removed for diagnosis needing microscopical diagnosis	149
Percentage of surgical specimens which need microscopical diagnosis	19.8
Percentage of diagnostic specimens	83

IV. PERCENTAGE RECKONED WITHOUT APPENDICES, GALL-BLADDERS, AND OVARIES

Total number of surgical specimens	1046
Total number of appendices, gall-bladders, and ovaries	321
Total number of surgical specimens minus appendices, gall-bladders, and ovaries	725
Total number necessary microscopical diagnoses	207
Percentage of necessary microscopical diagnoses	28

These figures clearly indicate that clinical medicine needs tissue experts in order to render efficiency to the patient.

Many clinicians and surgeons have the impression that they can make their own pathological diagnoses, but this is but an impression which is rarely, if ever, corrected by them statistically. Such impressions must be filled with error in the light of the fact that tissue experts with very extensive experience can diagnose only about 75 per cent of all specimens grossly; and if they rely upon old standards of microscopic diagnosis, they find themselves face to face with a possibility of microscopic diagnosis in only about 95 per cent.

The clinician's clinical diagnostic error is usually thought of as being about 5 per cent. As a matter of fact, in such a superficial organ as the mammary gland, his actual error is from 2 per cent to 26 per cent when he makes positive diagnoses. His apparent error, by which is meant that error in pathological terminology which does not affect the patient, is 8 to 50 per cent.

His natural acuity and honesty have led him to avoid clinical error in from 1 to 57 per cent of different mammary conditions by utilizing such terms as tumor, nodule, mass, growth, benign (?), malignant (?), or by making no diagnosis.

When he utilizes such a term as carcinoma (?) for example, which he does in 8 per cent of his cases (1800), his guess is correct in 57 per cent (1).

These figures represent the condition of diagnostic efficiency in one organ which compares favorably with his efficiency in the diagnosis of many conditions in other portions of the body, which will be published at some future date.

The main factor in which the writer is especially interested at this time, however, is the terminological inefficiency represented by the clinician's attempt to utilize detailed pathologic terminology for clinical purposes. His code of communication of ideas has an inefficiency of from 1 to 57 per cent, which is too large to be scientific, although when utilized with the help of tissue pathologists it may not prove inefficient in so far as the patient is concerned, because what the clinician and surgeon really want to know, in the breast for example, is whether the condition is benign or malignant, operable, inoperable or nonoperative. Clinicians have been led to believe, however, by pathologists, that conditions are either benign or malignant, which is only theoretically true.

The theoretical line of demarcation is similar to the one dividing two pieces of property; it has never been seen. The fence,

be it one inch or three feet thick, is the practical line of demarcation, and so it is in pathology; there is a practical, histological, biological, and clinical line which was first described before this society in 1908 (2). Coincidentally with this description, a new observation was made relative to the rôle played by regeneration in the life history of tissues and the recognition of the process of regeneration as a protective process of cells against an antagonistic environment.

It was later recognized that this reaction of cells is similar to the protective activities of all living matter.

It was seen that during the structural and functional evolution of multicellular organisms, certain phenomena occurred. Specialization and differentiation of cells were coincident with a diminution of power of reproductivity, which, in order to preserve such cells or tissues in the presence of constant or periodic destruction, must of necessity be carried on by reserve cells, the function of which is tissue reproduction.

The reactions of these reserve cells (textoblasts) represent, histologically, hypertrophy, hyperplasia, and migration, which biologically mean hyperactivity, reproduction, and change of environment, and clinically mean benignancy, an indeterminate condition, and malignancy. There is one other phenomenon which is of significance in association with hyperplasia, that is, attempt at tissue differentiation, which sometimes occurs in the expansive and migratory conditions of hyperplasia. It is well known that the so-called malignant cells (migratory hyperplasia) attempt differentiation when they arrive in an environment which is favorable to such a change (3).

It is the lack of this phenomenon in the so-called indeterminate stage which prevents the expert microscopist from prophesying clinically just what will occur. How can he read in undifferentiated cells of living structures just what they intend to do?

It is this stage which has produced confusion among pathologists and has caused some to call certain conditions malignant and some to call them benign. It is the stage of cytologic activity which makes the differentiation of some chronic inflammatory conditions from malignant conditions difficult, in fact impossible.

It is the biological significance and importance of regeneration with its stages which the pathologists who were dealing with dead tissues and end-results failed to recognize.

It is well known that all but a few tissues are capable of regeneration, and in the case of most tissues the reserve cells are recognizable.

The regenerative neoplastic conditions were originally described in the following terminology (4):

Primary (restauro-) (benign)	adeno- cardiomyo- chondro- endothelio-	melano- myo- myxo- neuro-	cytoplasia or neoplasia
Secondary (expando-) (?)	erythro- fibro- glio-	osteo- perithelio- pilo-	
Tertiary (migro-) (malignant)	leiomyo- leuco- lipo- lympho-	poly- rhabdomyo- etc.	

This conception has been and is applied efficiently to tissue diagnosis from a clinical standpoint.

Although it is applicable to regeneration and neoplasia, it is not representative of all the visible biological phenomena which occur in tissue reaction, and is not, therefore, complete from the standpoint of either the clinician or pathologist, although it has formed a basis for study, correlation and description of all of the other phenomena.

There are six fundamental reactions to antagonists which manifest themselves microscopically or macroscopically:

1. Cytolysis.
2. Atrophy.
3. Hypertrophy.
4. Neoplasia.
5. Differentiation.
6. Inflammation.

There are seven conditions involved in the basis of the newer conception of pathology and its terminology:

1. Type of cell.
2. Normal activities of cells.
3. Biological reaction of cells to antagonists in their environment.

4. The degree of reaction of cells.
5. The gross tissue manifestations of cellular reaction.
6. The duration of reaction.
7. The antagonists which caused the reaction.

There are at least 28 different kinds of cells which form human differentiated tissues which constitutes the human organism:

audito-	fibro-	melano-	pilo-	} Cyte(3)
adeno-	glio-	myo-	poly-	
cardiomyo-	gusto-	myxo-	rhabdo-	
chondro-	leiomyo-	neuro-	sebo-	
endothelio-	leuco-	odoro-	tactilo-	
epithelio-	lipo-	osteo-	tendo-	
erythro-	lympho-	perithelio-	visio-	

There are three degrees for each reaction:

Cytolysis
1. Destruction of the cellular wall.
2. Destruction of the cellular wall and destruction of the nuclear wall.
3. Destruction of the whole cell.

Atrophy
1. Reduction of the cytoplasm.
2. Reduction of the cytoplasm and nuclear plasm.
3. Reduction of the whole cell.

Hypertrophy
1. Increase in size of the cytoplasm.
2. Increase in size of the cytoplasm and nuclear plasm.
3. Increase in size of the whole cell.

Neoplasia
1. Hypertrophy of regenerative cells plus presence of differentiated cells.
2. Hyperplasia of regenerative cells plus absence of differentiated cells with or without partial differentiation.
3. Hyperplasia of regenerative cells plus migration with or without partial differentiation.

Differentiation
1. Partial grouping of cells according to normal grouping.
2. Incomplete normal morphology of tissue cells.
3. Complete normal grouping and normal morphology of tissue cells.

Inflammation
1. The cardinal signs of inflammation (rubor, tumor, calor, and dolor).
2. Rubor, tumor, calor, and dolor, plus ulceration.
3. Rubor, tumor, calor, and dolor, plus pus.

The biological reactions sometimes manifest themselves grossly as:

1. Circumscribed
2. Noncircumscribed
3. Papillary
4. Polypoid
5. Cystic
6. Ulcerated

} conditions.

They occur in relation to time as:

1. Acute
2. Chronic

} conditions.

If these facts be correlated, they arrange themselves in the manner shown in Table I

TABLE I

Acute / Chronic	circumscribed, noncircumscribed, papillary, polypoid, cystic, ulcerated	primary, secondary, tertiary	audito-	fibro-	melano-	pilo-	cytolysis
			adeno-	glio-	myo-	poly-	atrophy
			cardiomyo-	gusto-	myxo-	rhabdo-	hypertrophy
			chondro-	leiomyo-	neuro-	sebo-	neoplasia
			endothelio-	leuco-	odoro-	tactilo-	differentiation
			epithelio-	lipo-	osteo-	tendo-	inflammation
			erythro-	lympho-	perithelio-	visio-	

TABLE II

Acute / *Chronic*	*circumscribed*, *noncircumscribed*, *papillary*, *polypoid*, *cystic*, *ulcerated*	primary, secondary, tertiary	audito-	fibro-	melano-	pilo-	*cytolysis*
			adeno-	glio-	myo-	poly-	atrophy
			cardiomyo-	gusto-	myxo-	rhabdo-	hypertrophy
			chondro-	leiomyo-	neuro-	sebo-	*neoplasia*
			endothelio-	leuco-	odoro-	tactilo-	differentiation
			epithelio-	lipo-	osteo-	tendo-	*inflammation*
			erythro-	lympho-	perithelio-	visio-	

which gives a plastic but definite terminological key to most of the pathologic conditions which we find in tissues.

The clinician can recognize positively only those conditions which are italicized in Table II, although he might possibly recognize some of the conditions in columns 1 and 2.

Time does not permit a detailed elucidation with examples of the application of this conception. Although perhaps not yet perfect and complete, it offers a simple conception with a simple code of communication; it is histologically, clinically, biologically and scientifically more efficient than the chaotic, extravagant, inconsistent, empirical, and clinically inefficient conception and terminology of tissue pathology which has come down to us from that great and essential period of observation and description which shall ever be remembered in association with the great masters of pathology who had a scientific strength of conviction which was great enough to break away from the mystic empiricism of the ages which had preceded them.

In conclusion it must be stated, in the presence of this body of progressive surgeons of America, that this new conception, as it exists, was not possible without a study of early conditions and processes which was made possible by what might be called prophylactic operative surgery as it is being practiced in association with expert microscopy.

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DEPARTMENT OF TECHNIQUE

SUTURE OF BLOOD-VESSEL INJURIES FROM PROJECTILES OF WAR

A Preliminary Report

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THE purpose of this article is to point out some of the more important details in the repair by suture of injuries of the larger blood vessels from war projectiles. The ligature of the main vessels of an extremity for the control of hæmorrhage seriously jeopardizes the life of that extremity, but this danger may be averted in many instances by suture, provided a certain degree of care be exercised in this attempt by the operator.

According to the statistics gathered from various operators engaged in service in the front area with the British forces, all seem agreed that gangrene follows the ligation of the popliteal artery in a very large percentage of cases. When gangrene does not supervene, however, the patient frequently suffers from the concomitant symptoms of an impaired circulation.

In the group of five cases presented herewith, wounds of the vessels repaired by suture showed an early and satisfactory restoration of patency, and gangrene from an insufficient blood supply was thus warded off.

Case 1. McK., G., private, age 28; November 10, 1917. Suture popliteal artery and vein. Examination showed a through-and-through shell wound of the left popliteal space. The hamstring muscles were badly lacerated. The clots were wiped from the wound and sharp bleeding followed. The popliteal vessels were exposed and the artery and vein were found lacerated. The bleeding was controlled by Jeger clamp, and a longitudinal opening measuring 5 millimeters in both vessels was closed with continuous silk suture. A flap of muscle was fastened over the line of suture for greater protection. After excising all the lacerated muscle, the Carrel-Dakin treatment of the wound was employed. The edges of the upper two-thirds of the wound were approximated with silkworm-gut sutures.

A tract of a shell wound on the right forearm was excised. On November 12, 1917, 48 hours after operation, the foot was found warm, the dorsalis pedis artery was perceptible, the pulsation normal. The upper angle of wound showed evidences of retention, the sutures were removed. On November 14, the Carrell tubes were removed, the wound was "bipped" and dressed with paraffined gauze.

November 18, 1917, the wounds of leg and arm were clean. The pulse and temperature were normal; the dorsalis pedis and posterior tibial arteries were pulsating vigorously.

The postoperative temperature during the first week varied from normal to 101° and the pulse from 88 to 112. November 19, 1917, the patient was transferred to the Base Hospital.

An attempt to obtain further information covering the case is now under way and will be embodied in a subsequent report.

Case 2. L. E. L., private, age 23; November 13, 1917. Suture popliteal vein. On examination a shell wound was found on the right hip and another on the right leg. The popliteal vein was partially severed. A longitudinal rent 12 millimeters long in the vein was sutured, the foreign bodies removed, "b. i. p. p." was applied to the wound and dressings of paraffined gauze.

A tract in the buttock was excised, the foreign body removed, and "b. i. p. p." and paraffined gauze dressings were applied.

November 18, 1917, the wounds were found clean and the patient was removed to the Base Hospital. November 23 patient wrote that he was getting along fine.

Case 3. McL., A. G., private, age 26; November 17, 1917. Suture of femoral vein. On examination a shell wound was found in the right thigh in the region of Scarpa's triangle. The internal saphenous vein was found severed. Profuse bleeding from the depth of the wound was found to be due to injury of the femoral vein. Suture of a rent 20 millimeters long in the femoral vein was performed. The Esmarch's bandage was then removed and bleeding was found to proceed from a tributary with three distinct perforations. Ligature of this tributary checked the bleeding. The contaminated tract was excised, and Carrel-Dakin tubes and dressing were applied after two-thirds of the wound had been sutured.

November 22, 1917, the wounds were found clean; no œdema, temperature and pulse normal. The patient was transferred to Base Hospital.

This patient writes December 14; "Was able to get out of bed." December 19, he walked about three miles from the hospital to the village.

Case 4. F. W., private, age 31; November 20, 1917. Suture of femoral vein. Shell wound of right and left thigh and buttocks. The perineum, scrotum and both testicles were lacerated and left testicle completely destroyed. Profound shock. Hypodermoclysis with glucose and bicarbonate of soda. Suture of the two large rents in right femoral vein controlled the bleeding completely. The damaged muscles were excised, the crushed left testicle removed, the right testicle repaired by suture, and replaced in the scrotum. The wounds of the buttocks and left thigh were cleansed and the lacerated muscles excised. Carrel Dakin dressings were applied and hypodermoclysis and proctoclysis administered.

November 21, 1917, the condition of the patient was much improved.

November 22, 1917, pulse 96; temperature 100°. The patient was transferred to the Base Hospital.

Report from Base Hospital: General condition, very anæmic and septic. November 30, there was hæmorrhage from the right femoral artery. The artery and vein were ligated below profunda followed by transfusion of blood. December 4, there was gangrene of the foot; amputated lower third of leg.

CASE 5. P. T., private, age 21; November 25, 1917. Suture of popliteal artery. Through-and-through shell wound of left thigh. A large oval opening (1¼ cm. long) was found in the popliteal artery just below Hunter's canal. The artery was sutured and the calibre of the lumen was reduced to one-half of its normal size. The tract of shell wound was excised, a branch of the femoral vein was ligated, and all the damaged muscles were excised. A flap of fascia lata was removed and fastened over the line of suture in order to protect the latter from erosion by the Carrel-Dakin tubes which were applied.

November 26, 1917. The highest temperature at any time was 99.4°; pulse 76. The circulation of the limb was very satisfactory. The patient was transferred to the Base Hospital.

December 12, 1917. The patient wrote that he was getting along nicely, had no pain, and that the Carrel-Dakin tubes had been discontinued.

The treatment of lateral and perforating wounds of the larger vessels by suture in war surgery has resulted in only varying degrees of success. That the results following its practice have not been more satisfactory may possibly be ascribed to a lack of proper regard and attention to some of the details in the technique. In the Balkan War, 1912–13, Wieting Pasha and Vollbrecht sutured the wounded vessels whenever possible because they agreed with Kuttner that the danger of gangrene is thereby very considerably lessened, and that a lumen decreased by suture is at least better than one quite closed by ligature. Jeger considered it doubtful whether the requisite asepsis could be secured in the field hospitals. In the reports of Delorme, Dupuy de Frenelle and E. Marquis the repair by suture is discouraged on account of the difficulties of technique. L. Sencert declares the results of suture as mediocre compared even with ligature which induces gangrene; for instance in a very large percentage of wounds of the popliteal artery.

Tuffier, however, in a discussion in the autumn (1917) meeting of the *Société de Chirurgie*, recommended suture for the wounds of the popliteal and femoral arteries in war surgery.

The failures in many of the cases reported may have been due to neglect of one or more of the essential points of the operation, which are:

1. A high degree of asepsis.
2. The segment of vessel to be sutured must be freed from all macroscopic blood and properly protected from all contact during the suture.
3. The sutures must not be introduced under too great tension.
4. Thrombosis is favored by bacterial infection, and by the tissue juices with their ferments. The lumen of the vessel to be sutured should, therefore, be thoroughly washed with Ringer's or saline solution, followed by liquid paraffin. Sutures introduced under tension may cut out and induce hæmorrhage.

The technique of a vascular suture, should, therefore, consist of the following steps:

1. A free exposure of the injured vessel.
2. A temporary occlusion of its lumen above and below the lesion, either by flexible clamps, serrefines or tape.
3. A thorough perfusion of the intervening segment with Ringer's solution or saline solution followed by liquid paraffin.
4. A removal with scissors of the adventitia encroaching upon the line of suture.
5. Silk sutures threaded on fine cambric needles and sterilized in liquid paraffin should be introduced through both media and intima, carefully avoiding the adventitia.
6. A deep vessel, requiring repair, may be rendered more accessible by lifting the vessel from its sheath upon two narrow ribbons. This procedure may entail a division, and ligation of one or more of the branches which hold the vessel in its normal anatomical position.
7. A walling off of the remainder of the wound with pledgets of black silk will assist materially in safeguarding the line of suture from thrombokinase, and will also serve to make the delicate white sutures more easily seen by the operator.
8. When a main artery is completely severed, a circular suture should not be attempted unless the severed ends can be approximated without tension. When this is not possible, a segment of vein can be transplanted, or when such a procedure is not practical a paraffined tube may bridge the gap and maintain the blood supply until an enlarged collateral circulation is established. The tube should then be removed.

Injuries to the blood vesse's of the extremities are more frequent than it appears from most of the reports of war casualties. This belief was verified during a brief visit recently to one of the Casualty Clearing Stations where the above five cases with wounds of main vessels of the lower extremities were found among 63 wounded soldiers operated upon by the writer. In all the 5 cases, the wounds of the vessels were sutured, and, during the observation of the cases, showed in each instance satisfactory evidence that the lumen of the vessel remained patent.

A SAFEGUARD IN INGUINAL ROUTE OPERATIONS FOR FEMORAL HERNIA

By MARTIN W. WARE, M.D., F.A.C.S., New York
From the Surgical Service of Dr. H. Lilienthal, Mt. Sinai Hospital

IN performing this operation, originally conceived by A. V. Moschcowitz, the one obstacle to its uniform and successful execution has been the difficulty of reducing the incarcerated or strangulated and gangrenous intestine. The difficulty referred to consists in readily and safely dividing the constriction at Poupart's (Gimbernat's) ligament from within by means of any guarded knife or bistoury. The proximity of the distended intestine makes such a procedure very precarious and hazardous.

Heretofore where I failed to relieve the constriction from within, I was obliged to resort to a free division of all overlying structures. Thus, by the stroke of the knife Poupart's ligament was severed. Quite naturally the intestine could be readily reduced if healthy, and dealt with accordingly if non-viable. But the division of Poupart's ligament is an unwarranted sacrifice, which renders its reconstruction eventually by suture impossible and also militates against the nicety and certainty in the obliteration of the orifice of the crural canal by suture of Cooper's to Poupart's ligament. Such division of Poupart's ligament also vitiates the reconstruction of the inguinal canal as a step of this operation. In either case, a relapse of the hernia would follow, necessitating the wearing of a truss even in anticipation of the recurrence and subsequently inviting an operation frought with considerable difficulty and uncertainty as to the outcome.

To circumvent this disaster I propose the division of the constriction from within by means of a fine silk thread. This thread can be passed by means of a Deschamp needle or any needle sufficiently blunted, or by means of the eyelet of a fine silver probe. By gently whip-sawing the thread a very exact and partial division of the fibers of Poupart may be executed, which can never injure the intestine, and sometimes the slightest excursion of the thread will be sufficient to re-establish the circulation of the intestinal contents and render the reduction of the gut possible. The thread may even be used as a tractor during the reduction. Thereafter it is divided and withdrawn.

In three cases of strangulated femoral hernia with incarcerated gut content, operated upon by the inguinal route this technical addition has proved efficient because it is performed very quickly with great ease and is fool proof against injury to the most impaired gut, and above all makes for the certainty of carrying out the operation in all its niceties and successfully.

AUTOPLASTIC NERVE TRANSPLANTATION IN THE REPAIR OF GUNSHOT INJURIES

By LEO MAYER, A.M., M.D., New York

THE suture of gunshot injuries of nerves which have been completely divided is in numerous cases rendered impossible, either by the extensive loss of substance suffered at the time of the injury or by the marked degeneration of the nerve stumps developing subsequently. In some cases, the hiatus between the nerve ends can be overcome by flexing the limb. This applies particularly to injuries of the median and sciatic nerves. In the case of the ulnar, something can be gained by transposing the nerve to a position anterior to the elbow. These methods, however, require extensive dissection of the nerve and immobilization of the limb in a position which, though at first physiological, gradually becomes pathological, owing to the formation of scar tissue. There is always more or less difficulty in straightening out limbs which have been flexed for the purposes of nerve suture; and it is by no means impossible that the gradual stretching to which the limbs have to be subjected has a deleterious effect upon the nerve regeneration. Certain it is that the percentage of recoveries, in a series of seventy nerve sutures

Figures 1 and 2. Photographs of a patient with an extensive injury to the musculospiral nerve six months after implantation of the external saphenous nerve to bridge a four-inch gap of the musculospiral.

performed by me, was distinctly less in all those cases in which this procedure had to be resorted to.

In a paper published in the *International Journal of Surgery*, for March, 1918, as well as in a book entitled *The Orthopedic Treatment of Gunshot Injuries*,[1] I have outlined a method of bridging the gap between nerve ends, which on *a priori* grounds is physiological, and which in practice has given unusually good results (see Figures 1-4). The method consists in the implantation of a sensory nerve from the same individual between the ends of the injured trunk. As the sensory nerve is too small to equal the diameter of the injured, several segments of the sensory must be used so as to build a nerve cable of approximately the same size as the divided nerve. The cable thus formed must have the axones of each segment brought into intimate contact with those which have been divided, if regeneration is to occur.

The technique outlined in these previous communications was by no means simple. I wish now to report a method which renders this method of nerve bridging easier. The essential is the utilization of a little clamp, described by Dr. Bunnell,[2]. The Bunnell clamp, designed for repair of tendons, lends itself admirably, by means of a slight modification, to nerve suture. The clamps (see Figure 5) are made of thin, flexible, spring steel obtained at dental supply houses (S. S. White matrix steel, gauge .003).

The original clamps had several longitudinal slits through which the needle could be passed. These are unnecessary for nerve work. The two arms of the clamp are held together by a little cuff. This in turn is fastened securely in position by means of a hæmostat, which at the same time serves as a convenient method of handling the clamp. The device is so simple that it can readily be made by any one who has a little mechanical ingenuity. Its great advantage lies in the fact that the nerve or tendon can be handled with a

[1] W. B. Saunders & Co.
Surg., Gynec. & Obst., 1918, xxvi, 103.

Figures 3 and 4. Photographs of a patient with injury to the ulnar nerve, 5 inches above the wrist, one and a half years subsequent to the implantation of the dorsal sensory branch of the ulnar to bridge a two-inch gap of the injured nerve. Note the absence of atrophy of the hypothenar muscles, the ability of the patient to spread his fingers apart and the comparatively slight atrophy of the interossei. This atrophy was distinctly more marked before the operation and gradually diminished subsequent to it.

minimal degree of traumatism. To make the technique clear, imagine an injury to the external popliteal nerve, which has resulted in a gap of 2 inches between the healthy axones of the proximal stump and the degenerated axones of the distal. The gap intervening is filled with a mass of scar tissue, which is resected as a preliminary to the suture. The external saphenous nerve is exposed from its origin in the popliteal space almost to the heel. It is regularly found in intimate association with the external saphenous nerve. It is about one quarter the diameter of the injured nerve and therefore four segments are necessary to form a nerve cable of the proper size. The nerve is freed, lifted from its bed at one end and doubled backward and forward, as indicated in Figure 6, making each length slightly greater than the gap to be bridged. The two little clamps are placed in position, as shown in Figure 6, and then the nerve trimmed with scissors or a sharp razor, so that each end will present a clean-cut cross

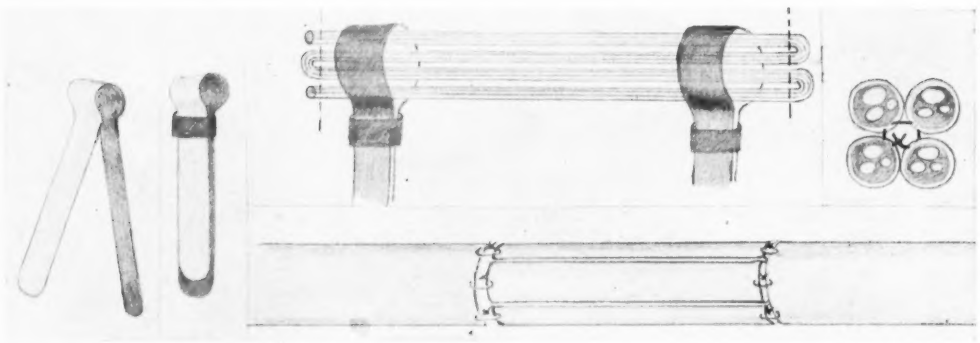

Fig. 5. Fig. 6 (above). Fig. 8. Fig. 7 (above).

Figure 5. The Bunnell clamp. *a* The clamp open; *b* the clamp closed, with the cuff in place.

Figure 6. Semi-diagrammatic sketch, indicating the manner of doubling the sensory nerve backward and forward, so as to form a nerve cable. The clamps hold the nerve-segments together; the dotted lines indicate the point where the nerve is cut across by the scissors or razor.

Figure 7. Semi-diagrammatic sketch illustrating the end of the nerve cable; a single stitch has been inserted holding the four nerve segments together. Note that the neurones present a sharp cross section, and can thus be brought into intimate contact with those of the injured nerve.

Figure 8. Semi-diagrammatic sketch, illustrating the implantation of the nerve cable between the ends of the injured nerve. It is held in place by fine perineural sutures, one at each end of each nerve segment.

section (see Figure 7). A single stitch is now taken, holding these four segments together, since otherwise they would come apart when the clamps are removed. The nerve cable is now fastened in place between the ends of the injured nerve by fine silk, perineural stitches, one at each end of each segment (Figure 8). The course of the injured nerve should be so altered as to lift it out of the scar tissue bed. Whether it is advisable to ensheath the line of suture with a vein, Cargile membrane, or hardened calf's artery is a question awaiting exact experimental answer.

The advantages of the transplantation method are:

1. There is no excessive tension on the line of suture.
2. Immobilization of the limb in a flexed position, with subsequent stretching, is not necessary.
3. The technique, when practised, is by no means difficult.
4. The clinical results, so far as I have been able to judge by my experience, are superior to any other form of nerve bridging operation.

A NEW METHOD FOR THE RELIEF OF LATERAL TENSION IN CLEFT-PALATE OPERATION

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In order to have the reader fully appreciate my method for the relief of lateral tension in cleft-palate operations it will be convenient to describe the technique of combined uranoplasty and staphylorraphy.

While much has been said and done in the surgical correction of these effects, the method universally employed is that known as Langenbeck's. The Langenbeck operation is accomplished by dissection of mucoperiosteal flaps obtained from either side of the cleft, and sutured in the middle line. Although called after the great German surgeon, and rightly so, inasmuch as he first clearly enunciated the principles underlying the operation, it is certain that similar plans had been previously employed by others.

Operations upon the soft palate were undertaken much earlier than upon the hard. As far back as 1760 a dentist named Lemonnier united the borders of a cleft in a child. Desault and others record similar cases in the first decade of this century.

M. Krimer seems to be the first who attempted operative treatment on the hard palate (1824). Dieffenbach, Warren, M. Beanfils, Avery Fraefe, M. Ronx, and a number of others, attempted surgical correction of palatal defects in the early part of the eighteenth century followed by Dieffenbach, Mason, Polloch, and a number of surgeons abroad and in this country.

The Langenbeck operation consists of the following steps:

1. Freeing of mucoperiosteal flaps.
2. Freshening the edges of the cleft.
3. Placing and tying of sutures.
4. Relief of lateral tension.

Freeing of the mucoperiosteal flaps. This procedure is accomplished by cutting the mucous membrane along the entire borders of the cleft and separating the soft tissue by periosteal elevators and cutting the tissue loose from the distal surface of the horizontal plates of the palate bone. This should be done with great care in order to prevent tearing or lacerating, which may seriously impair nutrition. Naturally this brings on considerable hæmorrhage which can be stopped by firmly pressing a sponge gauze against the bleeding surface. It is not always possible to avoid wounding the anterior palatine and especially the posterior palatine artery. Should one of the vessels be nicked it will cause severe and prolonged hæmorrhage. It is therefore better completely to divide the vessel so that it will contract at its ends, thereby overcoming protracted bleeding.

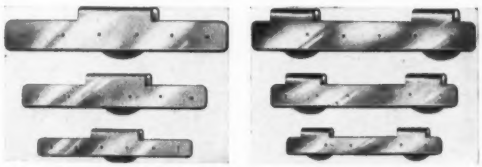

Fig. 2 (at left). Type A. Author's tension plates.
Fig. 3. Type B. Author's tension plates.

Freshening the edges of the cleft. This can best be accomplished by grasping the uvula on one side with a catch forceps and putting tension on the soft tissues, then with a very sharp thin-bladed knife cut a thin marginal strip along the entire flap from the uvula to the apex of the cleft. This same procedure is to be carried out on the opposite side. The freshened surface should be cut square with the flap tissue. A beveled surface is conducive to inviting failure. If the raw surfaces are cut square, it is an easy matter to bring them together in close apposition which will enable rapid union during the healing period. In cases in which there seems to be a shortage of tissue in the soft palate I prefer to split the border of the velum about one-eighth of an inch and then unite the raw surfaces.

Placing and tying of sutures. Various kind of suture material has been adopted for holding the pared edges together, such as silk, horsehair,

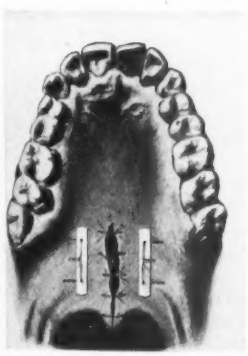

Fig. 1.

Fig. 4.

Fig. 5.

Fig. 1. Showing lead plates with wire ligatures cutting through the soft tissues.

Fig. 4. Showing a cleft involving the hard and soft palate.

Fig. 5. Author's tension plates in position. The borders of the cleft can be brought in contact by pulling on the wire and can be held in place by crushing the perforated lead shot.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 6. Showing cleft closed with type A tension plates.
Fig. 7. A wide cleft of the hard and soft palate.
Fig. 8. Same cleft closed using the author's type B tension plates.

linen, catgut, wire, etc. Personally I do not believe that the difference in value of the above named suture material is of any great consequence, provided the operator does not depend upon the same to overcome lateral tension. Sir William Ferguson, in 1844, recognized that the tension on the ligatures frequently invited failure, either through their cutting out or by shutting off the circulation, thereby bringing on starvation necrosis and infection. To overcome this tension Ferguson divided the levator palati, the palatoglossi, and the palatopharyngeal muscles. In 1860 Agnew believed that the tensor palati muscles were responsible by pulling the newly approximated surfaces on the soft palate apart, thus causing the sutures to pull out. Therefore he advocated making an incision close to the hamular process of the sphenoid bone, and in this way overcoming tension. For a long time these methods were extensively adopted by operators in this and foreign countries. The end-results were not satisfactory. This was pointed out in a paper by T. W. Brophy in 1901 in which he says: "The formation of cicatrices following incision renders the soft palate thick and unyielding, so that its function is performed imperfectly." Brophy finds it unnecsseary to cut the muscles on either side. It was he who introduced the application of lead plates. The advantages claimed for these plates are that they render the palate inflexible and prevent the cutting out of the sutures. Blair reports that he has discontinued the use of lead plates as a retention device because they occasionally cause sloughing, in spite of every care; he depends entirely upon the sufficient freeing of the flaps. In my experiences I have never found that the plates cause sloughing, but that they did not prevent the cutting out of the sutures (Fig. 1). They are, however, of a distinct advantage in rendering the palate inflexible. In order to prevent the cutting of the suture through the soft tissue I have devised a new tension plate which will prevent the suture material from cutting out and at the same time relieve the tension as well as render the palatal tissues inflexible. These plates are made from noncorrosive metal B. I. B. American gauge 22, in various sizes and types (Figs. 2 and 3).

The object of these plates is to prevent the cutting out of the wire ligature which frequently happens with the Brophy plates. In order to fit these plates, it is necessary to make a small incision near the gingival border of the last molar, being careful not to cut the palatine artery. (The operator must take into consideration the degree of the cleft, the position of the blood vessels and the type of plate that best suits his purpose.) The incision should be of sufficient length to permit the flange of the plate to enter and lie between the palatal bone and soft tissue. Previous to fitting these plates it is necessary to pass silver wire (American gauge 24) through the mucoperiosteal flaps and then through the holes in the plates. The ends of the wire are then passed through perforated lead shot and made tense by pulling the wire and crushing the shot, after which the borders of the flaps can be approximated without tension. After this is done I denude the border of the cleft and then place and tie the coaptating sutures after the McCurdy method.

While to the beginner it is rather a difficult procedure properly to fit these plates, he can, with

Fig. 9.

Fig. 9. "Button-hole" opening in the center of the palate.

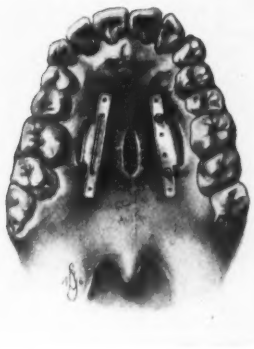

Fig. 10.

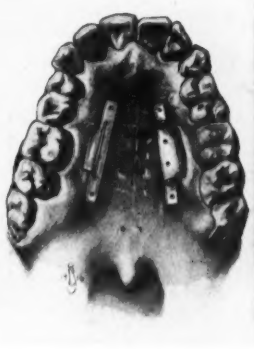

Fig. 11.

Figs. 10 and 11. Showing advantage of using type A tension plates for closing the opening shown in Fig. 9.

a little patience, soon master the technique of this simple procedure as an aid in obtaining uniform anatomical as well as physiological results.

Figure 4 illustrates the cleft of the hard and soft palate. Figure 5 shows the same case with the plates in position. Figure 6 shows the same case and the operation completed. These plates are now relieving the center ligatures so that healing can take place without tension.

Figure 7 shows an extensive cleft of the hard and soft palate. This patient, for years, had been wearing an obturator. Fig. 8 shows the same case with the palatal opening closed and held so with type B tension plates. Healing took place rapidly in this case and the patient was discharged ten days after the operation.

Figure 9 illustrates the so-called "button-hole" opening in the center of the palate. This form of opening usually is the end-result of an attempt to close the hard and soft palate. Figures 10 and 11 show the advantage of using the author's type A tension plates for closing such openings.

PLACENTAL TISSUE AS A GALACTOGOGUE

By EDWARD L. CORNELL, S.B., M.D., Chicago
From Clinic of Chicago Lying-In Hospital and Dispensary

FOR many years the medical profession has sought an efficient galactogogue, but until now it has not succeeded in securing anything which has proven of undoubted value, although various methods have been employed such as different drugs, autotherapy, glandular therapy, massage, electricity, and dietary measures.

Glandular therapy has recently been brought to our attention, and remarkable results have been obtained with it in the hands of some physicians. Others trying the same methods have not been so successful. Pituitrin has been given hypodermically and while it is continued an increased flow of milk is secured. The extract of the thyroid gland has been recommended with like results. It is questionable, with our present knowledge of the effect of these drugs, whether it is advisable to continue their use over an extended period.

At the suggestion of one of the manufacturing companies[1], I became interested in the use of placental tissue as a galactogogue. The preparation I used is made from the placenta of cows. The placenta is washed and dried, after which it is put up in 5-grain capsules. In the early cases the results were not very satisfactory as the dosage had not been determined. After experimenting, I finally decided that 5 grains given

[1]Parke, Davis & Co.

TABLE I

Case No.	Para	Nationality	Age	Sex of Babe	Birth Weight	Day began to gain	Weight on 10th day	Remarks
1	1	Jew	20	F	7–13.5	6	7–7	
1*	1	Jew	39	M	6–8.25	4	6–3	
2	1	Jew	23	M	6–8.25	4	6–10.25	
2*	6	Jew	31	M	9–9.75	5	8–13	
3	2	Jew	..	F	6–11.5	4	6–10.5	
3*	1	Swede	24	M	7–12	..	7–7	Forceps. Hæmorrhage.
4	2	Jew	22	M	8–4	5	8–7	
4*	2	American	25	M	8–5	..	7–15	
5	2	Jew	27	F	6–13	4	6–9.75	
5*	5	Scotch	35	F	8–6.75	..	8–2	
6	2	Jew	28	M	7–8	4	7–4	
6*	4	Jew	29	M	7.75	..	7–8	
7	5	Jew	29	F	6–8.5	4	6–7.75	
7*	2	American	34	F	8.50	6	7–3.50	
8	1	American	32	M	7–7.5	5	7.75	Forceps.
8*	2	American	..	M	8–12	4	8–8	
9	3	Jew	26	M	8–2	5	7–15	
9*	3	Jew	29	F	7–9.25	5	7–5.25	
10	2	Jew	27	M	7–4.25	4	7–8.25	
10*	2	American	25	M	6–9.50	5	6–7	
11	1	Jew	22	M	6–10.25	4	7	
11*	3	Jew	29	F	8–14	4	8–6.75	
12	1	American	33	M	8	6	7–6.25	
12*	2	Jew	31	M	7–14.25	5	7–11.25	
13	2	American	23	M	8–1.75	4	8–2	
13*	2	American	30	M	8–3⅜	4	7–15.75	Mid-forceps.
14	2	Jew	27	M	7–10.75	4	7–10.25	
14*	7	Jew	36	M	7–13.25	5	7–12.75	
15	1	American	27	M	8–11	4	8–9.75	
15*	3	American	26	M	5–4	6	5–1.25	
16	5	Jew	27	M	8–3.25	4	7–13.75	
16*	1	Jew	23	F	6–7	5	6–5.25	
17	1	Jew	20	M	5–11.75	4	6–2	
17*	1	Jew	25	F	6–9	6	6–10	
18	2	Jew	26	M	6–3	4	6–9.5	
18*	1	American	31	F	5–8	5	5–14.25	
19	1	Jew	22	M	6–13.5	5	6–15.5	
19*	1	Jew	23	M	7–6.75	4	7–1.75	
20	1	American	22	M	8–6	5	8–5.75	
20*	2	American	20	F	7–5.50	5	7–1.25	
21	1	Jew	20	M	7–9	5	7–6.25	Breasts pumped.
21*	1	Dane	24	M	7–12	6	7–7	Mid-forceps. Supp. feed.
22	3	Jew	30	F	7–9	5	7–1.5	Babe gastro-enter.
22*	1	American	39	M	6–8.25	4	6–2.25	
23	3	Jew	25	M	7–9	4	7–14	
23*	6	American	31	M	9–9.75	5	8–13	
24	1	Jew	20	M	6–9	6	6–6.75	
24*	2	American	24	M	7–6.50	5	7–4.75	
25	3	Jew	34	F	6–10.5	5	7	
25*	5	American	35	F	8–6.75	6	8–1.25	
26	1	Jew	24	F	5–15	5	6–2.5	
26*	2	American	25	M	8–5	6	7–15	
27	1	Polish	22	M	8–12.5	5	9–4.25	Pumped 1 oz. milk daily.
27*	4	Jew	29	F	4–6	7	4–5.75	Supp. feeding.
28	2	Irish	22	M	6–5.5	5	6–1	Cæsarean section.
28*	10	American	45	M	8–3⅛	5	7–7.50	
29	12	Jew	36	..	7–6	5	7–6.5	
29*	1	American	28	M	7–12.75	6	7–8	Modified milk given.
30	2	Jew	24	F	6–9.5	4	6–10	2 oz. milk daily.
30*	1	American	20	F	8.75	4	8–1.75	
31	1	Jew	24	M	6–7.5	6	6–1.75	
31*	1	American	20	M	7–1.75	4	7–4.25	
32	1	Jew	22	F	6–1.5	4	6–3.75	4.5 oz. milk daily.
32*	1	American	29	M	7–8	6	6–15.75	Forceps.
33	1	Jew	20	M	7–10.25	..	7–11.25	
33*	1	American	22	M	9–2.50	5	9–4	
34	1	American	27	F	6–3.25	5	6–12.5	
34*	3	Jew	30	F	8–2.50	5	8–4.50	
35	1	American	22	M	6–14.25	5	6–12.25	Breasts pumped.
35*	3	Jew	30	M	9–2⅜	4	8–10	
36	1	Jew	28	M	5–13⅞	4	5–11.75	
36*	1	Jew	24	F	7–3	6	7¾	
37	4	Polish	28	M	7–10	5	7–3	Breasts pumped.
37*	2	Jew	26	F	6–14	4	7–8⅛	
38	2	American	22	F	5–11¼	4	5–8	Babe lost for 3 days.
38*	2	Polish	22	F	7–11.50	5	7–5.75	
39	2	Jew	29	F	7–7	4	7–10⅝	
39*	2	American	29	M	8–2.50	6	8–9	
40	2	Jew	26	F	7–4⅛	4	7–13.5	Breasts engorged.
40*	2	Swede	32	M	9⅜	6	8–6.75	
41	1	Jew	20	M	8–7	4	8–12.5	Breasts pumped.
41*	3	Jew	32	F	8–8	4	7–15⅜	
42	1	American	36	M	7–15	5	7–14.75	
42*	2	Jew	22	M	8–1	4	9–2.25	
43	1	Jew	20	M	6	5	6–1¼	

*Cases which did not receive placental extract.

TABLE I—*Continued*

Case No.	Para	Nationality	Age	Sex of Babe	Birth Weight	Day began to gain	Weight on 10th day	Remarks
43*	1	American	33	F	7-5⅜	6	6-14	
44	2	Norwegian	23	F	8-2⅞	5	7-8.25	
44*	2	Austrian	28	F	8.25	6	7-9.50	
45	1	American	22	M	8-10.75	5	8-7.5	Breasts pumped.
45*	3	Jew	24	M	7-15.25	4	8-6	Cæsarean section.
46	2	Irish	27	F	7-1.75	4	6-12	
46*	7	Jew	43	F	9.50	4	8-15	
47	1	Jew	27	F	6-3.5	6	6-1	
47*	1	Jew	29	M	5-9.25	4	5-8	
48	2	American	22	M	6-5⅞	4	6-7	
48*	1	American	24	F	8-1.50	4	8-3.25	
49	2	Swede	30	M	6-13⅞	5	6-14.25	
49*	1	American	24	F	9-2.25	6	8-13.25	
50	2	Jew	31	F	8.5	5	7-11	Breasts pumped.
50*	2	American	26	M	9-4.75	5	8-12.50	
51	1	American	24	F	8-2.5	5	8-4⅞	
51*	4	Austrian	34	M	7-6.75	5	7-5.50	
52	1	Jew	20	F	6-11.25	5	6-13.5	
52*	3	Jew	30	M	7-5.50	5	7-3.50	
53	1	Jew	20	F	6-13.25	4	6-14.5	
53*	1	American	22	M	7-14	5	8-1.50	
54	2	Swede	22	F	5-11.25	5	5-11.5	Breasts pumped.
54*	1	German	21	M	6-14.25	7	6-8	
55	2	American	24	M	10-2.25	5	9-3.5	
55*	2	Jew	27	F	8-11.75	5	8-1.50	
56	2	Jew	..	M	7	5	6-15.5	
56*	3	Jew	29	M	8-3⅛	6	7-12	
57	2	Jew	25	F	7-10.5	5	7-7.25	
57*	1	American	22	M	9-2.50	6	9-4	
58	1	Jew	26	M	8-3	6	7-8.75	
58*	1	Jew	23	M	8	6	7-4	
59	1	American	..	M	6-3	5	6	
59*	1	Jew	25	F	6-14	5	6-14.50	
60	2	Jew	27	F	6-13	4	6-13.5	
60*	1	Jew	21	M	6	5	6.75	
61	2	Jew	26	F	9-4	5	8-5	(Weight on 9th day.)
61*	1	American	27	M	8-4	5	8-1	
62	4	Jew	30	F	7-9.75	4	7-6.75	(Weight on 8th day.)
62*	1	American	36	F	5-12.50	4	5-12⅞	
63	3	Jew	31	F	7-2.75	5	7-6.5	
63*	3	American	32	F	7-10	5	6-15.50	
64	1	Jew	20	F	7-1.5	5	7	
64*	4	American	28	M	9-1.75	4	8-15.75	
65	1	Jew	23	M	6-7.75	5	6-1	
65*	1	Jew	24	M	6-2.25	5	5-14	
66	1	Jew	24	F	6-9	4	7-0	
66*	2	Lithuanian	26	F	7-8.25	5	7-4	Cæsarean section.
67	6	Jew	..	F	7-8	5	7-1.75	
67*	4	Jew	35	M	7-8	4	7-6.75	
68	2	Jew	..	F	6-14.5	5	6-13.75	(Weight on 9th day.)
68*	1	Jew	22	F	7-10	4	7-2.50	
69	2	Swede	30	F	7-7.5	5	7-6	
69*	3	American	32	M	5-13.75	4	5-13.75	
70	1	American	29	M	5-7.25	8	5-5⅛	Supp. feeding.
70*	1	Jew	22	F	7-6.25	4	6-9.50	
71	1	Jew	25	M	4-5.5	4	4-10	
72	2	Austrian	25	M	7-2.5	5	6-15⅝	Supp. feeding.
73	2	Jew	29	F	7-1.25	5	7-3⅜	Occ. post. Mid-forceps.
74	3	Jew	30	F	6.5	4	6-7.25	(Weight on 8th day.)
75	1	American	24	M	7	4	7	
76	2	Jew	29	M	9-5	5	8-13.5	(Weight on 9th day.)
77	1	Jew	23	M	7.75	4	7.5	(Weight on 11th day.)
78	2	Jew	26	F	7-4⅞	5	7-4.75	(Weight on 9th day.)
79	1	Jew	20	F	7-5.25	5	7-5	
80	1	Jew	26	F	6-15.75	4	7-2	Breasts pumped.
81	2	Jew	23	M	7-6	4	6-15.25	
82	2	Jew	21	F	8-6.25	5	8-2	
83	2	Swede	37	M	6-8	5	6-10.5	
84	2	Jew	28	M	7-4.5	5	6-13.75	
85	3	Jew	30	M	8-13	4	8-14	
86	1	Jew	26	M	6-2.5	5	6-9	
87	3	American	26	M	6-15	4	6-11.5	Nursed 3 babies on 4th day
88	2	Jew	26	F	7-13	4	7-11	
89	2	American	24	F	7-6.5	7	7-2	
90	1	American	20	M	7-7.25	5	6-12.25	
91	2	American	39	M	9-4.25	5	8-14.25	Supp. feeding.
92	4	Jew	33	M	8-11.5	4	8-3	Mod. milk given.
93	1	American	24	F	6-7.5	5	6.75	
94	2	Swede	22	F	7-14⅛	5	7-12⅛	
95	1	Jew	22	M	7-14	6	7-4.25	
96	1	Jew	22	F	7-12⅞	5	7-11.75	
97	1	Polish	29	M	7-6.75	5	7-8.5	
98	1	American	26	M	7-11.25	4	7-13	
99	1	Jew	24	F	4-5⅞	9	4-2.25	
100	2	Jew	25	F	7-0	4	7-12.5	

*Cases which did not receive placental extract.

TABLE II

Day babes began to gain	No placenta	Placenta
4th	22	40
5th	25	47
6th	17	6
7th	2	2
8th	..	1
9th	..	1
Not mentioned	4	3
	70	100

TABLE III

	No placenta	Placenta
Percentage regaining birth weight	24	44
Number of babes requiring supplemental feeding	3	0
PATHOLOGICAL CASES:		
Forceps and hæmorrhage	3	1
Cæsarean section	2	1
Occiput posterior and forceps	0	1
Forceps	0	1
Mothers supplying milk to others	0	13

four times a day for 12 doses is the most satisfactory. The first dose is given as soon as the patient is able to take nourishment and has had a rest from labor. Generally it is given within 12 hours after delivery. No bad effects were noted on the gastro-intestinal tract. Some few patients objected to the odor of the preparation, but, aside from that, no trouble was encountered.

The placenta was used in more than 100 cases, but as the results were not satisfactory in the first cases, I have selected the last 100 cases upon which to report. The patients entered the hospital without a private physician and were assigned as staff cases. Seventy patients, who entered during the same period and were placed on the same floor and under exactly the same conditions, are recorded for comparison. Please note that the food was not changed. In a three-bed ward frequently there would be one or two to whom the tissue was not given, but who were cared for by the same nurses, etc.

Table 1 gives in detail the results obtained in the 170 cases reported.

Tables 2 and 3 are self-explanatory.

CONCLUSIONS

1. Placental tissue has a favorable effect in the production of milk.
2. Nationality, age of patient, and sex of baby play no part.
3. Eighty-seven per cent of the babies whose mothers had received placental tissue began to gain on the fourth and fifth days against 69 per cent whose mothers did not receive the medication.
4. Forty-four per cent regained their birth weight before leaving the hospital against 24 plus per cent.

A CONSIDERATION OF URETERAL STONES

THEIR REMOVAL BY AID OF THE OPERATING CYSTOSCOPE; REPORT OF CASES

BY E. P. MERRITT, M.D., ATLANTA, GEORGIA

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THE question of ureteral stones is sometimes very interesting as well as puzzling. If the X-ray would show every stone we thought to be present, sometimes our labors would be ended before we started. This agent does show most ureteral stones, and probably would show more if the proper preparation of the patients were made previously and great care used in studying the plates. The literature compiled from various sources, gives about 75 per cent positive findings per X-ray. The main confusing shadows that have to be considered, and brushed aside on account of location and resemblance, are phleboliths and pathologic mesenteric glands. This may be successfully done by use of the iron oxide catheter inserted in a suspected ureter, plus the urinary findings, although the latter findings are not very helpful in some cases. As a rule there is a history of ureteral disturbance, such as colicky attacks and tenderness.

Thirteen cases have come under my observation of late; five women and eight men. All five of the women had left-side stones, and six of the men were also affected on the left side. The stones ranged in sizes from a small almond down to a match head. All were visible with the X-ray except one. All had typical attacks of colic except one. In the family history of six of the group were symptoms traceable to stone, the mother or father having suffered from stones. All had pus-cells in the urine, six had some infection, four had red blood-cells. In the

majority of these cases the stone was lodged about the pelvic brim or just below, and was usually expelled after the second or third trial. In no case were there more than four efforts necessary to expel the stone.

A few points valuable in getting quicker results I think should be emphasized; hot sitz baths and hot applications over the affected side. Morphine should be used freely. Novocaine or papaverin sulphate solution should be injected in the ureter preceding olive oil injections. I think urethral irritation from the cystoscope aids materially by setting up reflex peristaltic waves. One case, not included in this report, who had suffered from stone in the ureter for a year, was demonstrated very clearly by X-ray. After meatotomy of urethra, he passed the stone the following day.

CASE 1. C.H.C., age, 25; white; occupation, farmer. The patient's mother passed some small stones at intervals in the last few years and had suffered from "kidney trouble" for a number of years. The patient gave a history of good health until two years ago. At this time he noticed pains in left side which were reflected to the left thigh, the left testicle and left side of the penis. He passed blood in that period of time twice. After a severe attack, the urine was milky looking (phosphates). He had intestinal disturbances and different forms of treatment gave no relief. Veneral diseases were denied.

March 16, 1918. Examined. Some tenderness was present over the left ureteral region, with reflex pains to left thigh, left testicle, and left side of penis. There was general gastric disturbance, with much gas in the intestinal tract. The urine was very heavy with phosphates, and showed a few pus-cells and streptococci, but was otherwise negative. Cystoscopic examination showed the bladder normal, the right ureteral orifice normal, the left orifice small and slightly red. The catheter would not go higher than about four and one-half inches. The X-ray showed a small stone in ureter at pelvic brim.

March 17. Ureter below the stone was dilated with catheter and forceps. March 20. On inspection of orifice, the stone was bulging through the meatus of ureter, which was opened. Without pain the stone passed that night.

CASE 2. J. A. W., age 55; occupation, minister, white. Three years ago the patient began to have colic-like pains in his left side, which required doses of morphine for relief. He lost weight, suffered from general nervousness from that time, and lived in fear of other attacks. Especially was he subject to great pain if he exerted himself.

Examination. There was slight tenderness over the left ureteral region. The urine showed a few pus-cells, but was otherwise negative. The X-ray showed a stone about the size of a pea at the pelvic brim. December 15, 1917. Cystoscopic examination. The trigone of the bladder was somewhat inflamed, the right ureteral orifice was normal, while the left looked somewhat red and slightly bulged. The catheter met obstruction at the stone. The lower part of the ureter was dilated, and injected with papaverin and olive oil. He had great relief for three days, then the same procedure was repeated, and he felt so much relieved that he went his way rejoicing, but came back in ten days suffering greatly. The ureteral meatus was cut and the ureter dilated again. He passed the stone a week afterward. Since then the pain and other symptoms have cleared up.

CASE 3. Mrs. J., age 30, white, about three years ago began to suffer with urinary disturbance, frequent urination and pains in her left side. She passed a small stone and was relieved for a while, but the symptoms returned and she was forced to seek relief.

Examination. She was very sensitive over the left kidney and ureteral region. The urine showed a few pus-cells and mucus. The X-ray showed a stone about two inches below the kidney pelvis. Cystoscopic examination showed the bladder to be normal, the right ureteral orifice normal, left slightly red and dilated. A catheter inserted in the left ureter met an obstruction high up. Injection of papaverin sulphate and olive oil, after increasing the severity of pains for about twelve hours, enabled her to pass the stone, affording immediate relief. All her reflex pains were directed to the left vaginal wall.

CASE 4. C. P., Greek; age 43; occupation, restaurant cook; had always been healthy, until six months ago when he began to have colicky attacks. The first attack lasted two weeks, keeping him in bed. After that, the attacks would come on at intervals of about every two weeks, being quite severe in character, with pain in left kidney region, referred to the left testicle and left side of penis, radiating down the left leg and thigh. He also had gas in the intestines with general gastric and intestinal disturbances. Urine contained small amount of pus and few red cells. Tenderness over left ureteral and kidney regions. X-ray showed large stone above pelvic brim.

September 25, 1917. Cystoscopic examination showed a normal bladder and right ureteral orifice. The left orifice was pouched, small and very red. The catheter stopped four and one-half inches up. The lower part of the ureter was promptly dilated. The patient had severe pains that night, saying he felt like something slipped and cut for two inches. He was free of pain for five days.

October 1, 1917. The catheter would not go up the ureter farther than one inch. The meatus was opened and the ureter dilated below the stone. That night he had a short, severe attack, followed by complete relief.

October 2, 1917. Cystoscope showed stone in bladder, left orifice red and swollen. Stone passed in twelve hours, and gastric and ureteral symptoms disappeared.

CONCLUSIONS

Ureteral stones in almost every case produce very annoying gastric symptoms. Several of my cases were treated for such symptoms but were not relieved until the stones were removed.

We should consider carefully the nerve supply of the ureter, namely: inferior mesenteric, spermatic, and pelvic plexus, for here is the answer to the symptoms of intestinal unrest.

It is a conservative statement to assert that 90 per cent of ureteral stones may be removed by the method outlined, thus avoiding a radical operation. A careful cystoscopist does no harm in the manipulations, even if he fails. The patient loses very little time, and adhesions that may follow a cutting operation are never produced. All ureteral stones should be removed for the health of the kidney. Stones that do not show by the X-ray, may be diagnosed by the wax-tipped catheter, urinary findings, obstruction, and other suggestive symptoms.

TRANSACTIONS OF SOCIETIES

CHICAGO SURGICAL SOCIETY

REGULAR MEETING, APRIL 5, 1918, DR. CARL BECK, PRESIDENT, IN THE CHAIR

DR. ROY L. MOODIE spoke on "Pathological Evidences of Diseases Among Man and Extinct Animals." (See page 498.)

SUBDIAPHRAGMATIC ABSCESS

Dr. Emanuel Friend read a paper entitled "Subdiaphragmatic Abscess." (See page 468.)

DISCUSSION

DR. LAWRENCE RYAN: The number of cases that I have had an opportunity to tabulate is not so large as that presented by Dr. Friend, but in some respects the material is interesting and differs a little from his. The first case was operated upon at the Cook County Hospital following an attack of amœbic dysentery. Two years before, this man while living in Georgia, contracted a diarrhœa; a diagnosis was made of amœbic dysentery and he was treated there for about a year for that condition. He came north after his symptoms had practically all subsided, but very soon thereafter complained from time to time of pain in his right side and of gradual disability. He would have attacks so that he could not work, and he became more and more disabled until he applied to the hospital for treatment. At the time his right side was quite painful. He had very little temperature. He was sent from the examining room with a diagnosis of pleurisy with effusion. Dullness on the right side was quite marked.

In looking over the records of cases at the County Hospital and of others which I have had up to the present time, there were 36 in all, but most of them were seen at the Cook County Hospital. Practically all of these patients complained of symptoms as in pleurisy with effusion, or with an empyema. The greater number of them were sent in to be operated upon for empyema. In some of them the physical findings were dullness on the right side which extended as high up as the second or third rib, and the X-ray findings were typical, except in a few where there was some effusion above the diaphragm. There was a little cloudiness of the picture above but with a high immobile diaphragm, such as you see here, there is no danger of making a diagnosis of anything except a subphrenic abscess, with the history of temperature, and so forth, or some growth below the diaphragm.

This patient had a very large area of dullness on the right side. He was operated upon, the abscess was drained, and while apparently drainage was sufficiently permanent to afford relief for several months, eventually the man died.

The next case is one of subphrenic abscess, but on the right side the condition is not so clear. The patient was operated upon for a pus appendix by one of the members of this Society. In the course of three or four months the patient developed symptoms which pointed to a subphrenic abscess. An incision was first made anteriorly and nothing was found; then a posterior opening was made, and a small amount of pus was found to be present, which was drained. This operation was done about a year and half ago. There has been a slight discharge from a sinus at intervals ever since. The symptoms gradually grew worse and this sinus was injected with bismuth paste. A diagnosis was made of subphrenic abscess.

The records of the County Hospital show that 8 patients out of the 36 died.

One of the best results we had was in a case where we resected the eighth and ninth ribs and established drainage. In the last case operated upon we went in over the eighth rib, resected it down to the costal margin and opened into the cavity, which held about a quart of pus with the bismuth paste. The cavity was wholly subphrenic as far as we could determine. For three months this man was expectorating purulent material with every evidence that it came from a collection of pus in his lung. The belief was that there was some communication between the subphrenic abscess and the lung itself. No direct communication between the two could be found, but there was an indication that he had another collection of pus above. In extending the incision upward I took out six inches of rib to have the cavity fill in. The pleura was opened just above. I put my finger in below; the pleura was sutured to the diaphragm, so that there was no bad effect from it and no infection of the pleura followed.

In the first case shown we resected two ribs, four inches of each, cut out the intercostal tissue between the two ribs, and the cavity at no time retained any pus. In a few cases among the records a through-and-through opening was made.

This case of subphrenic abscess was opened with the understanding that it was a case of pleurisy with effusion or empyema. The fistulous tract was injected with bismuth paste later. Here is another view of the same case showing the outer bismuth

area, with extension up above into the pleura. There were four or five of these cases that had permanent fistulæ. Some of these fistulæ were discharging pus through the bronchi, and one or two patients expectorated bile not infrequently. One patient we had at the County Hospital during the winter, who did not stay for an operation, was expectorating bile quite frequently.

Many of these cases have been examined bacteriologically and in various other ways. One thing that struck me in these cases of amœbic dysentery is that they have a distinct amœbic history very frequently; that after the attack of diarrhœa the first year or two and recover from it. In no case were amœba coli found in the fæces or in tis ue after the patient entered the hospital, although nearly every case was examined for bacteria by the interne in charge. One patient had 16 bacteriological examinations made with a view to locating the organism, but without success.

The bad results in some of the cases came from inadequate drainage at the start. There was one point in which these cases differed clinically from those of Dr. Friend, namely, that a large percentage of them gave a history of gall-bladder infection. I started out with the understanding that many of these cases were due to pus appendix or to a perforating gastric or duodenal ulcer, but examination of case records convinced me that many of them follow chronic infection of the gall-bladder.

There is one class that is more acute than Dr. Friend mentioned. In some cases of perforated gastric ulcer the patient may have an acute subphrenic abscess running along the upper surface of the diaphragm, he has chills, and presents the clinical picture of a pneumonia. If you examine a patient after the rupture of such an abscess, with the infection traveling to the upper surface of the diaphragm, you will find very little pus, but the physical findings are those of a pneumonia due to the extension of the virulent form of infection that caused the subphrenic abscess.

Dr. Daniel N. Eisendrath: I have had altogether about ten cases of subphrenic abscess, and I want to endorse what Dr. Friend has said in regard to the value of X-ray examination. I believe today that there are two methods which have supplanted practically all our means of physical diagnosis and exploratory puncture in fully 75 or 80 per cent of the cases, namely, the X-ray plate method and fluoroscopic examination. I want to recommend especially fluoroscopic examination. In my last few cases I have gone into the X-ray room and have been edified by watching the movements of the diaphragm which you cannot get in a cold plate. In a case of this kind if you watch the manner in which the diaphragm moves, i.e., instead of moving up and down symmetrically as it does on the two sides, you will observe a difference in the manner in which it rises on the side where the subphrenic abscess is, and you will gain more information than you will by the ordinary plate method.

It is not frequent for these abscesses to be as large as those Dr. Friend and Dr. Ryan have shown. Of the 10 cases I have seen, in many of them the abscesses were small, not containing more than three or four ounces of pus, yet rendering the patient so septic that one died before we could recognize the abscess. That was in the earlier days before we used the X-ray in diagnosis, and autopsy showed the abscess located not along the upper portion of the diaphragm but along the lateral portion.

There are certain anatomical points to be considered. In the first place, I endorse what Dr. Ryan has said in regard to the etiology. Not all of them are due to appendicitis. Fully 75 per cent of those on the right side are due to appendicitis, but in one of my cases it followed a subacute perforation of the gall-bladder, and in another a perforation of a duodenal ulcer. Of the appendicitis cases, in practically all of them I have seen, the appendix was retrocæcal, so much so that I have profited by it in that I make it a rule now if I operate upon a perforated or gangrenous appendix with retrocæcal abscess, to insist on putting the patient in the Fowler position in order to prevent the formation of subphrenic abscess.

With regard to the treatment, I wish to mention the method of Elsberg, of New York, who evacuates these abscesses by the subphrenic route. I have tried in several instances to go through the transpleural route, and in one case there was such a severe empyema that the patient died, so that I have tried in all other cases, and have been successful since then, to follow Elsberg's suggestion, depending on a knowledge of the anatomy of the pleura. The pleura is reflected at the seventh, ninth, and eleventh ribs. If you take the axillary line and resect a portion of the tenth rib, you can very easily push up the diaphragm and pleural reflection at that point, enter the subphrenic space and drain the subphrenic abscess without entering the pleural cavity.

I thought it might be of interest to you to mention this. I have dissected it on 26 cadavers and find it is true. There is a little variation sometimes in the pleura in certain cadavers, in that it will go down almost to the eleventh rib. In the majority of them it goes to the lower border of the tenth rib, and if you reflect the tenth rib and push the diaphragm up, you can enter the subphrenic space and drain the abscess safely in that way.

Dr. Arthur Dean Bevan: First, I would like to emphasize the importance of operating upon these cases of subphrenic abscess under local anæsthesia. If the diagnosis has been established from the clinical signs and X-ray examination and confirmed as a rule by the operating needle, the operation can be so thoroughly done under local anæsthesia and with so much greater safety to the patient that a general anæsthetic is not necessary.

I want to emphasize what Dr. Ryan has said with reference to the importance of making a wide opening, to obtain not a mere puncture with drainage,

but free drainage that enables one to drain the entire cavity. Another point I would like to lay stress on is that many of these cases will not do very well after drainage because of the fact that the original focus persists after mere drainage. Some of them, even after apparent recovery, recur because of the persistence of the original focus. I have had three or four cases where the original focus was the appendix, and where after the primary operation the patient did very well even to the extent of having the process apparently clean up entirely and of being away from the hospital for several years, and then came back with a recurrence of the subphrenic abscess. One case we had comparatively recently in which the patient was entirely well for three or four years after drainage of a subphrenic abscess, and he came back to the hospital with another subphrenic abscess. We drained him the second time. While he was in the hospital apparently recovering he had a definite attack of appendicitis. We operated upon him and found a large fæcal concretion in the appendix, which was the primary focus.

It is not good judgment nor is it wise surgery at the time of the original operation, when the symptoms are very acute, to search exhaustively for the primary focus. Very often it is wise not to pay any attention to it; but from the experience I have had in these cases, I think we should attempt as far as we can to unravel the case completely. If we had a subphrenic abscess, drained it, and the patient improved, and we were unable to ascertain definitely the fact that the appendix or the gall-bladder or a duodenal ulcer was the focus, we should not dismiss the patient after improvement or recovery without considering seriously attacking the primary focus and eliminating it and the possibility of further trouble.

DR. FRIEND (closing): I fully concur in what Dr. Bevan has said in regard to these cases, and particularly with reference to operating under local anæsthesia. Many of these patients are so emaciated and in such a wretched condition that local anæsthesia is the method we should employ wherever we can. I would like to emphasize again the matter of supraclavicular pain.

A STUDY OF THE DEVELOPMENT OF THE EPIPHYSES AS A VALUABLE GUIDE IN FRACTURES AND DISLOCATIONS IN THE YOUNG

DR. PHILIP KREUSCHER read a paper entitled "A Study of the Development of the Epiphyses as a Valuable Guide in Fractures and Dislocations in the Young." (See p. 480).

DISCUSSION

DR. ARTHUR DEAN BEVAN: I am very much obliged to Dr. Kreuscher for giving me a personal opportunity to review this work. I know that very frequently, especially with men who have not a very wide experience in fractures and dislocations, men are misled because they do not understand how to interpret these centers of ossification and epiphyseal lines at various ages. I think it is a subject well worthy of consideration, and one that we should keep constantly in mind.

Personally, one of the difficult things I have to deal with is to interpret injuries of elbow-joints in children where the centers of ossification are not of large size and especially where there is very much swelling.

DIAGNOSIS AND TREATMENT OF URETERAL CALCULI

DR. DANIEL N. EISENDRATH read a paper entitled "Diagnosis and Treatment of Ureteral Calculi." (see p. 461.)

DISCUSSION

DR. ARTHUR DEAN BEVAN: The older I grow, the more conservative I become in connection with ureteral stone work, from two standpoints: first, from the standpoint of the difficulties that are met in making an accurate diagnosis; and second, from the standpoint of the possibility of the patient being quite as well off without an operation as with it. In other words, in many of these cases the indication for the operation is quite relative, and not positive. Of course, when we all began to do this stone work in the early days, and I believe I did the first that was done in the United States, in 1897, we very shortly made a great error in connection with ureteral stones. At that time, or shortly thereafter, when the technique of the X-ray apparatus improved, Leonard of Philadelphia about 1902 or 1903 startled all of us with the statement that in making some 150 pictures of suspected ureteral stone and renal calculi, he was very much surprised to find that ureteral calculi were very much more common than stones in the kidney, and he presented at one of the meetings of the American Medical Association a large series of excellent X-ray plates and lantern slides demonstrating that fact. As a matter of fact, very few of Leonard's cases were operated upon and very few of them were ureteral calculi.

Later it became perfectly clear that many of these cases were simply centers of ossification in the pelvic ligaments opposite the spine of the ischium. That was a common mistake made by Leonard and other earlier observers. Dr. Joseph Smith, who was then with me in X-ray work, at my suggestion took several hundred plates that had been made of the pelvis indiscriminately in our laboratory and we found in 26 per cent of these plates there were the same shadows in the pelvis which had been mistaken by Leonard and others for ureteral calculi. On the basis of that, I made a number of dissections in adults. The common cause of these shadows was centers of ossification in the pelvic ligament opposite the spine of the ischium. There are undoubtedly other causes, such as Dr. Eisendrath has said, and

among them calcification in lymph-nodes, phleboliths, and one very interesting thing is that of foreign bodies in the intestinal tract. I will cite one or two cases, in particular which we have had recently.

I was called in consultation with a prominent surgeon and internist to see a man who was very much distressed. He had applied for life insurance and they found pus in his urine. The X-ray picture showed distinctly a stone in the ureter. It was about the size of the end of my little finger. The case was seen by a good surgeon who advised immediate operation. I took a more conservative view and could not see any urgent need for operation.

One thing that attracted my attention in connection with this case, as in the shadows shown by the assayist, was that there was not the same density throughout, and in the particular case I refer to I urged taking another picture in a few days, passing the ureteral catheter, and taking an X-ray in that way. A few days later at the suggestion of the roentgenologist, the patient took a good sized physic of some kind to empty the bowels, after which another picture was taken and the shadow had disappeared. Later another picture was taken and the shadow was not present. In other words, there was a foreign body of some sort in the intestinal tract which had passed.

I want to emphasize the point that the indication for operation in these ureteral stone cases is relative. In the presence of any emergency, like anuria, there may be a positive demand for operation. We must use good judgment in determining whether in a particular case a stone may pass normally or not. In our work it is a routine with us, where we have a stone of the size of a coffee berry or smaller, unless there is a definite and urgent indication for its removal, to leave it alone and watch the case, because we find in many of these cases the stones will pass normally. Some of them are assisted by the introduction of oil into the ureter. Unless there is a very definite reason, I do not like to operate for the removal of ureteral stones in the lower end of the ureter deep down in the pelvis. As far as stones in and near the kidney are concerned, and stones of good size, in the greater part of the ureter above the pelvis, there is very little question that they should be operated upon and can be operated upon with a good deal of safety to the patient.

I would like to say a few words in regard to the technique. In the upper ureter we are using the ordinary oblique kidney cut, but for the greater part of the ureter we use the same incision as for an appendix case, except that we make the old type of extraperitoneal operation, such as was made for ligation of the iliac vessels in years gone by. Where we want to make an extensive and wide exposure of the ureter, if a wide incision is necessary, we carry the splitting of the internal oblique across the rectus and strip up the peritoneum, isolate the ureter and find the stone.

I think a certain technique should be followed because of several experiences we have had. After the ureter is exposed and the stone found, a smooth hook should be placed on the ureter above the stone. In several cases we have had the stone slip back into the kidney. Very often the ureter above the stone is dilated and you have the same difficulty you have with a stone in the common duct. In feeling around for the stone, it is like squeezing a lemon seed between your fingers, it slips up and you have to make an extensive oblique kidney cut before you get the stone. We put a hook on the ureter above the stone, and a second hook below the stone; the ureter is incised, the stone removed and the ureter dropped back without making any attempt to suture it. A small ciagarette drain is introduced and carried down to the ureter, and it is surprising how rapidly, as a rule, the edges unite with very little leakage. Some of these cases will not leak a drop after an incision half an inch long in the ureter. Some will leak for a short time. Almost none of them are associated with anything like persistent fistula, provided the stones have been removed.

I must say that stones in the ureter low down in the pelvis have been a great bugbear to me. Anatomically, they are very difficult to get at. Some of them I approach through the perineum. Several times, when we have had a large stone impacted in the lower end of the ureter, I have done a right or left old-fashioned lateral lithotomy, and instead of incising the prostate and exposing it, I have followed the prostate up to the ureter, then incised the ureter over the impacted stone, removed the stone, and simply drained in that position. I do not think it is at all a standard operation, nor do I know that it has found its way into the literature, but in impacted stones of fair size the lower end of the ureter, it seems to me it is a safer procedure than any other.

If I say anything of value in this discussion, I would like to re-emphasize the position of being extremely conservative in our ureteral stone work, of demanding a very definite diagnosis before commiting one's self to an operation, in the first place, and in the second place, of analyzing all the facts, the size of the stone, the possibility of the passage of the stone—a judicial weighing of the evidence for and against an operation—before one undertakes to remove it surgically.

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD FEBRUARY 15, 1918

EXTREMELY YOUNG ECTOPIC PREGNANCY

DR. N. SPROAT HEANEY: This specimen I think will prove of interest from several points of view. In the first place, the obstetrical history is of interest. The patient's first pregnancy terminated in what was thought to be incomplete abortion. She was curetted, but soon after her dismissal from the hospital, the attending physician found that she had one tube markedly enlarged. She had a great deal of pain in that side and was sick for several weeks afterward so it is highly probable, in view of her subsequent obstetrical history, that this pregnancy was an ectopic pregnancy.

Last July I saw the patient in consultation, during her second pregnancy, which was a ruptured tubal pregnancy of the left side. This tube was removed at operation. Her former physician being in service, she recently came to see me giving the following history: Since operation she had menstruated regularly, each period lasting three days; that her last period came one day earlier but otherwise was as normal — lasting for three days. Since she was hoping to become pregnant, she was greatly disappointed by the recurrence of the period. She considered the period entirely normal in every way. It stopped as usual, but three days later the period returned — at this time with cramps. The flow was intermittent and at times very profuse and had lasted 5 days when I saw her. Since this was so unusual and because of her bad ectopic history, I advised her to go to the hospital for investigation. The night of her admission the pains were very severe, though no swelling in the region of the tube could be palpated. The uterus was quite small, in fact too small even to allow of the suggestion of a uterine pregnancy. Though the pelvic findings were negative, the cramps and her previous history made me decide to etherize her and to investigate the case. At first I curetted the uterus which contained no removable substance whatever. I then opened up the cul-de-sac and a few drops of dark blood escaped. Palpating the tubes with the finger through the colotomy opening, I could discover no enlargement. I then enlarged the opening and brought the uterus through it into the vagina for inspection. The left tube was missing. The left ovary was normal. The right side appeared perfectly normal at first glance. Still I could not explain the presence of her pain nor the presence of the drops of blood found in the cul-de-sac. It was only when I delivered the infundibular end of the tube that I found this little pregnancy.

You will see that it is not over half a centimeter thick and not over one centimeter long. Since the patient was very anxious not to be sterilized, I resected that portion of the tube containing the pregnancy so that it is not absolutely impossible for her to become pregnant again. I previously had explained to her that as a result of this operation the opening into the tube might close and she become sterile, or that another ectopic pregnancy might occur, or, a more remote possibility in view of her history, a uterine pregnancy might result.

The case is interesting to me from the fact that she had what appeared to be a perfectly normal menstrual period in every particular, and that I removed a pregnancy eight days afterward; also because this was probably her third ectopic pregnancy, and also because there were no uterine scrapings. If I had depended for my diagnosis in this doubtful case upon scrapings from the uterus and the presence of decidual cells, or upon palpable tubes I could not have made the diagnosis of ectopic pregnancy. I think this case is a recommendation for incision through the vagina in suspicious cases and recommend that, if at first sufficient pathology is not found to explain the case, a more thorough inspection should be made. In such cases it also shows that vaginal operation is an advisable procedure.

Dr. Rudolph Holmes read a paper entitled "Management of Breech Cases."

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS ON OBSTETRICS AND GYNECOLOGY

By GEORGE GELLHORN, M.D., F.A.C.S., St. Louis

THE duties imposed upon obstetrics by the Great War are daily becoming more imperative. "Wars are not paid for in war-time," said Benjamin Franklin, "the bill comes later." This truth applies not only to economic conditions, but to eugenics as well. The decrease of the birth-rate which was observed throughout the civilized world prior to the war, is bound to become more marked every day the conflagration in Europe continues. If thus the quantity of the breed cannot be increased, it is obviously incumbent upon obstetrics to safeguard the quality of the offspring. And as every movement for betterment depends, in the last analysis, upon education, we must needs redouble our efforts of educating the masses in the proper care, both prenatal and postnatal, of children. The living, spoken word and demonstrations would best serve our purpose, but books will go where lecturers cannot penetrate. The appearance on the market, therefore, of numerous books and booklets on the care of mother and baby is to be warmly welcomed. Several of these books have found their way to the reviewer's shelf.[1-4]

The praiseworthy tendency to disseminate knowledge is common to them all, and there can be no doubt that they will do a great deal of good. It would be well for physicians to pay more attention to this class of literature so as to be able from personal acquaintance to recommend to their patients an intelligent and reliable guide through pregnancy and to instill into them a realization of their part in the upbringing of children. Physicians will, then, see for themselves that some of these books, desirable though they be on general principles, fall short of their mark. A book, for instance, which introduces terms such as ectopic gestation and toxæmia, without ever explaining these expressions, shows defects that mar the excellency of the balance of the text. A book which devotes two chapters to a detailed account of the technique and the pros and cons of "twilight sleep" and "sunrise slumber" respectively, which supplies prescriptions for sore throat, nose bleed and what not, is constructed along faulty lines. As a rule, however, these "mother's guides" very sensibly refrain from giving advice which would lead the reader to think that she can do without a physician, and such books should be commended.

"Eugenic legislation," says Havelock Ellis in one of his admirable "Essays in War-Time," "is a secondary matter which cannot come at the beginning. It cannot come before our knowledge is firmly based and widely diffused; it cannot come until we are clear as to the ideals which we wish to see embodied in human character and human action; it cannot come until the sense of personal responsibility toward the race is so widely spread throughout the community that its absence is universally felt to be either a crime or a disease." This wider vision of the subject is well represented in two of the books before me. In "My Birth," Mrs. Lamson has chosen a most interesting and novel way to convey her message. She lets her own as yet unborn child tell, in words that every one can understand, the story of its development from a primordial ovum to a fully matured fœtus that is about to be born. No detail is missing. The growth of the graafian follicle, the meeting with the spermatozoon, the segmentation of the ovum, the origin of the various organs and structures are narrated in this delightful autobiography, and even tubal pregnancy and congenital malformations find their place in the tale. A small book of 140 pages, and yet a complete textbook on embryology made accessible to a circle of lay readers and adorned with numerous illustrations from medical works of recognized authority. Every now and again the little autobiographer branches off; he calls attention to the practical application of the facts revealed and makes an appeal to young mothers not to allow commercialized fashion and fad to penetrate the peacefulness of infancy and early childhood and hinder the normal development of a tender body, mind, and soul. Let us hope that there will be many young mothers who are sufficiently intelligent and earnest to read and assimilate this treatise.

The book which I enjoyed even more and which I read with unflagging pleasure from cover to cover, is Sarah Comstock's "Mothercraft." The aim of the book is "to put into non-technical English some of the newest teachings expressed by some of the safest and sanest specialists of today; in other words, modestly to act as interpreter." The greatest profession in the world, that of mother-

[1] The Expectant Mother and Her Child. By Margaret J. Modeland, R. N. Philadelphia: The John C. Winston Company.
[2] The Mother and Her Child. By William S. Sadler, M. D. and Lena K. Sadler, M.D. Chicago: A. C. McClurg & Company.
[3] My Birth. The Autobiography of an Unborn Infant. By Armenhouie T. Lamson. New York: The Macmillan Company.
[4] Mothercraft. By Sarah Comstock. New York: Hearst's International Library Company.

hood, is carried on by an army of untrained workers. A large majority of our mothers do not know the A-B-C of scientific motherhood. The amateur mother of yesterday must, in the interest of the race, give way to the professional mother of tomorrow. These few sentences characterize the tenor of the book. An easy-flowing style, a multitude of examples and illustrations taken from daily life, brings the work within the ken of women of all strata of society, and the insistence on prevention is bound to make them more eager to place themselves under the care of competent physicians and to co-operate more willingly and intelligently with their suggestions. The reviewer feels that we would do our patients a real service in urging them to read and re-read this book on mothercraft.

IN the field of preventive medicine and in the fight against quackery, the physician's natural helper is the trained nurse. It is to her that Ramsey addresses himself in his book on the "Care and Feeding of Infants and Children."[1] For the properly trained nurse, says the author, the subject of child-welfare offers a field capable of greater fundamental service to humanity than almost any other. She begins her work during the pregnancy of the mother and in every way possible prepares her to assume her new duties with a proper spirit of responsibility. After delivery she sees that the best interests of the baby as well as those of the mother are properly conserved. Even among the very poor and ignorant, it is surprising to see how quickly a crowd of ill-fed children can be transformed by the weekly visits of the child-welfare nurse. Such a family becomes a model for the neighborhood, with the result that the physical and moral tone of the community is distinctly improved. The actual instruction of the nurse in the care of healthy or sick babies is extremely well done; there is no superfluity of text, no expounding of mooted or theoretical topics, and the clearness of diction is still further enhanced by a number of really useful illustrations. This book deserves to become most popular among nurses.

THERE are several other books for nurses which should be mentioned in this connection.[2 and 3] Robb has edited, for the fifth time, his book in which, in 1894, he laid down the technique practiced in the gynecological and surgical departments of the Johns Hopkins Hospital. In this latest edition, certain necessary changes have been made, and a chapter on endometritis has been added.

Parker and Breckinridge have constructed their book on a more comprehensive basis than is usually found in nurses' textbooks. There is no dearth of illustrations showing instruments laid out on tables, patients in various positions, bandages neatly rolled up or applied to various parts of the patient's anatomy, samples of record sheets and fever charts, detailed directions for specific operations and pre- or postoperative care; but in addition, the authors supply the reader with facts the knowledge of which should change her from an automatic, however efficient, by-stander into an understanding and intensely interested co-worker. There is a very clear interpretation of the nature of infection with special emphasis on infection in wounds. The chapter on pathology contains a lucid discussion of the changes in the body cells and their activities brought about by disease, the mechansim of the healing process, the defenses of the body against infection, the disturbances of local and general functions, etc. All this should prove eminently useful and stimulating to the student and help her to establish still more firmly the enviable reputation of the American nurse in the world.

[1] LIPPINCOTT'S NURSING MANUALS—CARE AND FEEDING OF INFANTS AND CHILDREN. By Walter Reeve Ramsey, M.D. Philadelphia and London: J. B. Lippincott Company.

[2] ASEPTIC SURGICAL TECHNIQUE. With special reference to gynecological operations, together with notes on the technique employed in certain supplementary procedures. 5th ed. By Hunter Robb, M.D. Philadelphia and London: J. B. Lippincott Company.

[3] SURGICAL AND GYNECOLOGICAL NURSING. By Edward Mason Parker, M.D., F.A.C.S., and Scott Dudley Breckinridge, M.D., F.A.C.S. Philadelphia and London: J. B. Lippincott Company.